A PARADIGM FOR DESIGNING AND IMPLEMENTING INSTRUCTIONAL TECHNOLOGY IN SECONDARY SCHOOL BUILDINGS FOR THE KINGDOM OF SAUDI ARABIA

By

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Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
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August 1998

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Instructional technology is making a significant impact on the design and planning of educational facilities in today's information age. The dissertation has investigated the implementation of the latest instructional technology for the Ministry of Education at the boys secondary stage schools in the Kingdom of Saudi Arabia. Moreover, the research has taken social, cultural, environmental conditions and educational philosophy into consideration when implementing instructional technology into the design of schools, therefore not harming the unique social structure. Designing for new instructional technology such as teleconferencing, multimedia, audience response systems, distance learning, virtual reality simulation and the use of the Internet, are explored to fit the requirements of the current school prototype and improve the learning environment.

The research explored different layouts for the classroom, In addition, competing design concepts of a multimedia learning center with the latest instructional technology are studied as part of the school layout and in an effort to enhance the learning environment. Allowing for flexibility and development in the different concepts that integrates with the school building. The research covered over 1043 secondary schools in all 13 Provinces of the Kingdom and recommends that the project to be implemented in three phases. With successful implementation, this study will place the Kingdom and its school system at the forefront of the information age as we enter the next millennium.

Plans for staff development are examined and different ways of preparation is addressed. Furthermore, it is recommended that a technology planning committee is formed at the Ministry of Education in order to make sound decisions about the instructional technology infrastructure, resource allocations and successful systemic upgrades which is needed in the future. The research also developed a conceptual investment model to ensure that the implementation of the project is optimized and that it can be financially sustained over its projected life.

Contributions of the study are categorized into a three tiered power structure, at the Ministry level, province level and at the school level. In advancing the instructional technology , therefore, the Kingdom's school buildings will become indicators of a world leading country in applying the technology in its facilities taking it into the 21st century.

CHAPTER I
INTRODUCTION

General

Designing educational buildings to last well into the 21st century demands that created architectural spaces not only follow the functional requirement of today's educational programs, but that they also support and enhance the emerging instructional technology, multimedia and communication needs. Research and development have yet to be applied to school designs on a scale required to keep pace with other efforts to improve education and the learning environment. The Kingdom of Saudi Arabia is no exception. Its school buildings are lacking the technology that will take the country into the next century.

The Kingdom, with its vast resources, has the ability to upgrade its educational facilities. This action would propel the Kingdom into the next century as a world leader in applying instructional technology in its facilities. But, if success is to be guaranteed, the Kingdom must take into consideration its unique culture, environment and educational philosophy. According to (Gayeski, 1995), not only must an architect know how to design for new technologies such as multimedia, teleconferencing, audience response systems and virtual reality simulations, but also they should consider the kinds of social, cultural and environmental conditions they wish to support.

The Kingdom owes much of its half-century of stability to the legacy of its founder, King Abdulaziz Ibn Saud. He was a remarkable leader whose imagination and vision launched Saudi Arabia from an isolated and little-known country onto the road to becoming a force with which to be reckoned. During his rule, King Abdulaziz laid the foundation for the modernization of Saudi Arabia. He strengthened the country's infrastructure and later introduced modern technology, health care and an improved system of education. A new era in the development of modern education began in 1953 with the establishment of the Ministry of Education on December 24, 1953, as part of the Council of Ministers. His Excellency, King Fahad Ibn Abdulaziz, was appointed the first Minister of Education and guided the Ministry's unprecedented expansion and modernization of educational resources.

Importance of the Study

From the outset of the First Development Plan in 1970 (Five-Year Development Plan), the main role of planning and developing education in Saudi Arabia has been to provide an appropriate, practical and organizational framework for the development process, with all of its economic, social and industrial dimensions. In the economic field, there was an early determination by the government to construct a national physical infrastructure of the highest quality. Free education was created and expanded to promote equality of opportunity in attaining the skills required for sustained development. This research is intended to support this concept and assist the Ministry of Education in implementing instructional technology in its secondary school buildings throughout the Kingdom.

In the last two decades significant improvements have occurred in computer technology for educational purposes around the world. However, with the significant changes in the technologies that can improve educational environments, the physical planning and designs of these facilities have not been adapted to integrate instructional technology into the Saudi Arabian secondary schools. With the advancement of instructional technology around the world, it is becoming more important to retrofit our school buildings to prepare for the information age. In his much-discussed book, Educational Facilities: Planning, Modernization and Management (Castaldi, 1994) described:

> It can be assumed, a priori, that the design of educational facilities reflects the educational thinking and architectural philosophy at the time when school facilities are proposed, planned, conceived, and constructed. The end product at any given time represents a blending of prevailing architectural concepts, dominant educational practices, and promising curricular innovations. The well-planned educational facility not only provides for the accepted and conventional educational practices that are widespread at that time but also includes features that can accommodate a few of the more promising foreseeable educational concepts of the future. (Castaldi, 1994, p.31-32)

Scope of the Study

This research investigates the implementation of instructional technology in boys secondary school buildings for Saudi Arabia. Furthermore, this research only addresses schools that are built by the Ministry of Education throughout the Kingdom. This study presents a paradigm for the Ministry of Education that suits the current situation of its school buildings and their environment. Furthermore, this study not only investigates the various layouts that are desirable for the classrooms, but also presents different concepts that can retrofit instructional technology for the current schools prototype. The research method in this study is to examine the different physical spaces and compare the different options with respect to implementing instructional technology in secondary schools.

Problem Statement

The Ministry of Education in Saudi Arabia is constantly building new schools throughout the Kingdom to cope with the increasing demand for educational facilities. As instructional technology progresses in the multifarious learning and educational environments and institutes, so does the need for solving learning problems. The current school designs are based on certain functional requirements and traditional teaching method so they perform within those taught subject. There had been no consideration in the design of secondary schools to integrate instructional technology and advanced communications as part of their layout. As the profession of architecture practice advances in a dynamic fashion, particularly as new educational instructional technologies evolve and concurrently so does the physical planning and design of new educational facilities. Today's educational facilities should no longer be designed in a traditional setting, where rows of seats and a blackboard dominate the teaching style but must be adapted to the fact that technology is part of our daily life. A horizon of opportunities to be utilized in our schools is open to achieve the best learning environment for generations to come in the 21st century.

Indeed, the Ministry of Education is facing the challenges of the 21st century by implementing instructional technology in its secondary schools around the Kingdom of

Saudi Arabia. Such instructional technologies, from teleconferencing to collaborative multimedia, are essential considerations in the design and construction of new school facilities and especially retrofitting the existing secondary schools.

Objective

The study began in response to the perception that traditional ways of designing educational facilities are becoming inadequate to support the needs of this information age, and the technological advancements that we are witnessing today. The objective of the study is to have a more effective and efficient educational system in the Kingdom, as well as to investigate different ways of integrating the latest instructional technology and planning strategies into the secondary educational facilities at the Ministry of Education in Saudi Arabia. More specifically, this study looks at establishing reliable and valid ways to upgrade school buildings in a rapidly changing world.

Goal

Recognizing the significance of instructional technology in the educational arena, this research will investigate the architectural planning necessary for implementing state-of-the-art instructional technology for the Ministry of Education at the Boys Secondary Stage school buildings in the Kingdom of Saudi Arabia. Moreover, the study will take into consideration the uniqueness of Saudi Arabian society, from its educational philosophy to the social aspects, and integrate these values with the latest technology for education. The goal would be to advance the educational sector into the 21st century and showcase these school buildings as indicators of Saudi Arabia being the world's leading country in applying instructional technology.

Research Design

The research examines how to implement instructional technology in secondary school system in Saudi Arabia. By investigating the current prototype school building design that are built by the Ministry of Education and direct observation of the educational system with its social values, the study favors the use of a case study research. Moreover, the research explores and examines why instructional technology is to be implemented at schools. Tremendous developments in the communication and technology sectors and especially in instructional technology has driven education into an information era, where current design theory, which is based on traditional functional requirements and needs has become obsolete. Today's instructional technology requires redesigning schools with new concepts that are based on new innovations in educational technologies.

Organization of the Dissertation

The research starts with an introductory chapter that gives a general understanding of the topic, states the problem that will be investigated and documents why it is important to improve the educational facilities in Saudi Arabia by introducing instructional technology.

Chapter II introduces the educational system and secondary school building in the Kingdom. It reviews the objectives, policies and philosophies regarding education in the Kingdom. Furthermore, it explores the developments of the Ministry of Education, the educational system and school buildings.

Chapter III concentrates on reviewing the state-of-the-art instructional technology in schools and illustrates how instructional technology is changing the architectural planning of educational facilities and especially educational spaces in schools.

Chapter IV describes the integration of instructional technology into the social structure of the country without adversely affecting the existing social and cultural environment. It also reviews topics ranging from current planning, social acceptance, and educational spaces in schools to how instructional technology would influence school designs.

Chapter V documents the implementation of instructional technology in the secondary school system for the Kingdom of Saudi Arabia. It details the different layouts that are possible for implementing instructional technology in classrooms. Additionally, it covers essential concepts for developing a multimedia learning center that houses the latest in communication technology for teaching and administrative purposes.

Chapter VI outlines the research findings, concluding remarks and recommendations. This chapter also discusses future work that is related to the educational sector in the Kingdom of Saudi Arabia, that is outside the scope of this research.

CHAPTER II
EDUCATIONAL SYSTEM AND SCHOOL BUILDINGS IN SAUDI ARABIA

General Education

The aim of general education in the Kingdom of Saudi Arabia is to provide students with the basic knowledge necessary for their daily lives. It also hopes to provide proper educational and religious guidance to develop their character and make them aware of their potentials. These aims are in the best interest of the individual and the country (Ministry of Education, 1977).

Secondary school education is considered the last level of general education before proceeding to a higher institution, such as a college or university. The common mission of secondary school education is stated below in two points (Educational Policy, 1970):

1. Opening opportunities to competent students and enabling them to continue their studies in higher institutes and universities of all specialities.
2. Preparing other students to work in the various walks of life at a decent level.

Educational Objectives

The main educational objectives stated by the Ministry of Education are as follows:

1. To make available to students opportunities for development and for participation in the growth of the community in which they live, and ultimately to assure that they profit from this growth.
2. To make religious education a basic component in all the elementary, intermediate and secondary stages of education and in all their literary and scientific branches.
3. To harmoniously coordinate science and technology as the most important means of cultural, social, economic and physical development.
4. To fit all education stages into the Kingdom's general development plan.
5. To provide for and expand on the various stages of education within the kingdom, resources are available so that education is free of cost for all individuals of society, from kindergarten through the postdoctoral level, both within the Kingdom and abroad (Ministry of Education, 1970).

Educational Policy

In 1970 the Supreme Committee for Educational Policy in the Kingdom of Saudi Arabia issued a basic document covering the fundamentals, goals and objectives of education. It is truly a comprehensive document that emphasizes the right Islamic orientation and provides for extensive scientific and technological developments, with the ultimate objective of achieving a future that promotes human dignity and prosperity.

Some measures will be embraced to improve the quality of education under the General Education Policies in the Sixth Development Plan (Ministry of Planning, 1995). They include the following:

1. Academic curricula and teaching methods will be reviewed, improved on and made more consistent with students needs, so as to encourage creativity and promote problem solving skills.
2. The introduction of computer science at secondary schools will be continued and widely taught at both intermediate and elementary stages.
3. Efforts will continue to reduce the disparity in regional distribution of educational facilities and to ensure that all educational facilities meet minimum standards.
4. The scope for decentralized management in the delivery of education services will be studied.

Ministry of Education

Education in the Kingdom of Saudi Arabia is overseen by four main authorities, namely, the Ministry of Education, the Presidency of Girls Education, the Ministry of Higher Education and the General Organization of Technical Education and Vocational Training. There are, however, other public authorities which provide their affiliates and their children with kindergarten, elementary, intermediate, secondary and adult education. Such authorities

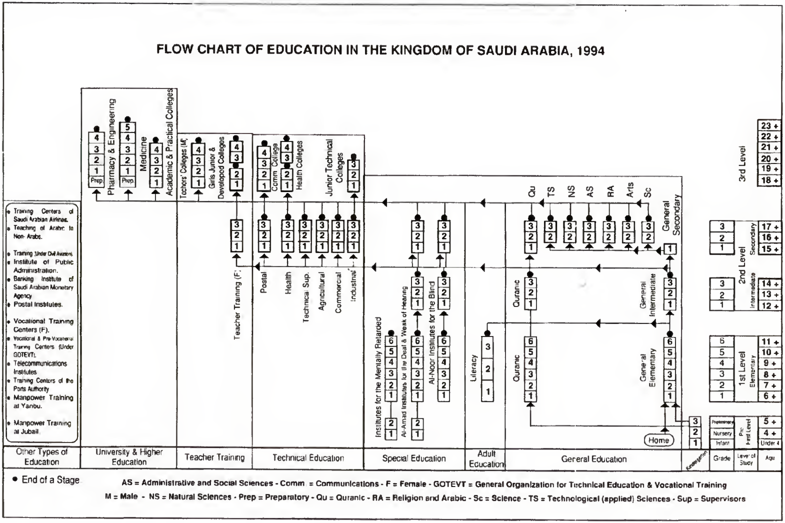

FLOW CHART OF EDUCATION IN THE KINGDOM OF SAUDI ARABIA, 1994
Pharmacy & Engineering
Prep
Medicine
Academic & Practical Colleges
Tchrs' Colleges (M)
Girls Junior & Developed Colleges
Teacher Training (F)
Comm College
Health Colleges
Junior Technical Colleges
Postal
Health
Technical Sup.
Agricultural
Commercial
Industrial
Institutes for the Mentally Retarded
Al-Amal Institutes for the Deaf & Weak of Hearing
Al-Noor Institutes for the Blind
Literacy
Quranic
Qu
TS
NS
AS
RA
Arts
Sc
General Secondary
General Intermediate
General Elementary
Home
3rd Level
2nd Level
Secondary
Intermediate
1st Level
Elementary
Pre First Level
Preliminary
Nursery
Infant
Kindergarten
23 +
22 +
21 +
20 +
19 +
18 +
17 +
16 +
15 +
14 +
13 +
12 +
11 +
10 +
9 +
8 +
7 +
6 +
5 +
4 +
Under 4
Training Centers of Saudi Arabian Airlines.
Teaching of Arabic to Non-Arabs.
Training Under Civil Aviation.
Institute of Public Administration.
Banking Institute of Saudi Arabian Monetary Agency
Postal Institutes.
Vocational Training Centers (F).
Vocational & Pre-Vocational Training Centers (Under GOTEVT).
Telecommunications Institutes
Training Centers of the Ports Authority
Manpower Training at Yanbu.
Manpower Training at Jubail.
Other Types of Education
University & Higher Education
Teacher Training
Technical Education
Special Education
Adult Education
General Education
Grade
Level of Study
Age
● End of a Stage
AS = Administrative and Social Sciences - Comm = Communications - F = Female - GOTEVT = General Organization for Technical Education & Vocational Training
M = Male - NS = Natural Sciences - Prep = Preparatory - Qu = Quranic - RA = Religion and Arabic - Sc = Science - TS = Technological (applied) Sciences - Sup = Supervisors

Figure 2-1. Flow chart of education in the Kingdom of Saudi Arabia
Source: Ministry of Education, Center for Statistical Data and Educational Documentation, 1996.

are the Ministry of Defence and Aviation, the Presidency of the National Guard and the Ministry of Interior. These authorities abide by the educational ladder, study plans and curricula enforced in the Ministry of Education and in the Presidency of Girls Education for boys and girls respectively.

Educational expansion has increased so rapidly since the early 80s that the Ministry of Education found it necessary to create school districts in different parts of the country to assist the Ministry in discharging its responsibility. Each school district is administered by a superintendent with a technical staff. Each school district is responsible for the day-to-day operation of schools under its jurisdiction, with overall direction emanating from the Ministry of Education.

Developments

Important educational innovations and reforms were introduced in 1988 by the (Ministry of Education, 1994), are as follows:

Issuance of a Royal Decree that reorganized the Ministry of Education and led to the creation of the "Directorate General for Education Technology." The new Directorate, consisted of two departments, "Design Department" and "Production Department", adopted the three following objectives:

1. To supply all types of advanced educational technology materials to schools, such as computers, equipment and videos;
2. To pay more attention to the design and production of educational materials;

3. To stress the training of senior staff of the Educational Ministry and educational districts in the fields of educational technology, teaching aids and equipments.

Based on the fact that investment in human capital is the cornerstone for future economic growth and social prosperity, the government has accorded its care and attention to the development of the education sector. This is reflected in the state budget expenditures on education, as more than $40.8 billion has been allocated for education over the Fifth Plan period. The educational expenditure accounts for 18 percent of the approved budget over this period. These allocations have enabled the education sector to achieve high growth rates across a range of educational variables, as shown for the general education sector in Table 2.1 during the Fifth Development Plan 1990-1994.

TABLE 2.1 AVERAGE ANNUAL GROWTH (%) IN GENERAL EDUCATION FROM 1990-1994, (MINISTRY OF EDUCATION, 1994).

LEVEL	Elementary		Intermediate		Secondary	
	Boys	Girls	Boys	Girls	Boys	Girls
Enrollments	3.8	4.6	7.4	10.1	5.4	11.0
New entrants	2.5	8.7	7.1	11.2	5.9	11.8
Graduates	6.2	6.9	8.5	10.1	8.0	12.0
Classrooms	3.6	7.5	7.0	10.0	6.7	11.8
Total teachers	5.5	7.0	8.7	10.8	11.4	13.7

The Sixth Development Plan 1995-2000 is targeted to continue to enhance and broaden the main objectives of the previous development plans and to meet the kingdom's development needs through the following (Ministry of Planning, 1995):

1. Maximizing the private sector's contribution in the provision of jobs;
2. Diversifying the economy to lessen its dependence on oil revenues;
3. Building a new physical infrastructure to meet the needs of the growing population;
4. Achieving a growth rate that is commensurate with the expansion of job opportunities for the Saudi labor force;
5. Improving social services, such as education and health;
6. Raising per capita incomes; and
7. Maintaining a balanced budget over the plan period.

The education sector in the Sixth Development Plan has been given priority as an essential strength for a future society. Paying attention to the quality of training by concentrating on the use of advanced technology at the intermediate and advanced levels and continually updating curricula and methods of teaching are two integral points of the Basic Strategic Principle in the Sixth Development Plan. This Sixth Development Plan will continue to evolve in the next 5 years and will witness the greatest challenges in reshaping our schools to fit state-of-the-art technology.

Secondary education in Saudi Arabia

The history of secondary education in Saudi Arabia started with the opening of the first school in 1926. By the end of WWII the entire country was served by only seven secondary schools, all located in the Western Province of AlHijaz (Al-Salloom 1995). According to (Gohaidan, 1981) secondary school education was based on the European system and consisted of a five-year course, but by 1958 had become a three-year program. In 1970 the Ministry of Education constructed and operated only 110 schools, but by 1996 the number of secondary schools had increased to 1,043 schools.

During the last two decades the overall growth of secondary schools was tremendous under the Ministry of Education. Table 2.2 shows the increasing number of secondary school buildings and students under the supervision of the Ministry of Education from 1970 to 1996. Figure 2.3 illustrates the growth of secondary school buildings during the same period.

TABLE 2.2 NUMBER OF SECONDARY SCHOOL BUILDINGS AND STUDENTS FROM 1970-1996, (MINISTRY OF EDUCATION 1996).

Year	# of Schools	# of Students
1970	110	14,058
1975	156	31,333
1980	343	64,626
1985	462	79,990
1990	581	127,042
1995	859	192,559
1996	1043	221,949

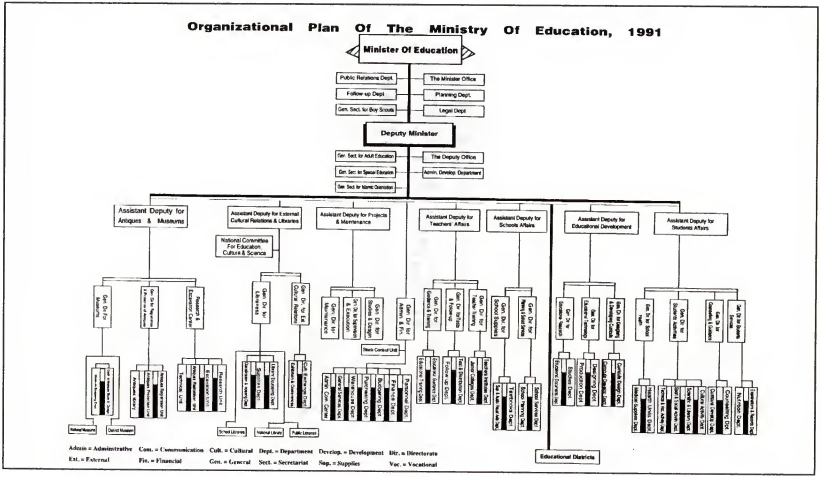

Organizational Plan Of The Ministry Of Education, 1991
Minister Of Education
Public Relations Dept.
Follow-up Dept
Gen. Sect. for Boy Scouts
The Minister Office
Planning Dept.
Legal Dept
Deputy Minister
Gen. Sect. for Adult Education
Gen. Sect. for Special Education
Gen. Sect. for Islamic Orientation
The Deputy Office
Admin. Develop. Department
Assistant Deputy for Antiques & Museums
Assistant Deputy for External Cultural Relations & Libraries
National Committee For Education Culture & Science
Assistant Deputy for Projects & Maintenance
Assistant Deputy for Teachers' Affairs
Assistant Deputy for Schools Affairs
Assistant Deputy for Educational Development
Assistant Deputy for Students Affairs
Gen. Dir For Museums
Gen. Dir for Registration & Protection of Antiques
Research & Excavation Center
Research Unit
Excavation Unit
Antiques Restoration Unit
Technical Unit
Antiques Registration Unit
Antiques Protection Unit
Antiques library
National Museum
District Museum
Gen. Dir. for Ext. Cultural Relations
Gen. Dir for Libraries
Cult. Exchange Dept.
Exhibition & Conferences
Library Equipping Dept.
Supplies Dept.
Classification & Indexing Dept.
Public Libraries
National Library
School Libraries
Gen. Dir for Admin. & Fin.
Gen. Dir for Studies & Design
Gen. Dir. for Supervision & Execution
Gen. Dir for Maintenance
Stock Control Unit
Personnel Dept.
Finance Dept.
Budgeting Dept.
Purchasing Dept.
Warehouse Dept.
General Services Dept.
Admin. Com. Center
Gen. Dir for Teacher Training
Gen. Dir for Tests & Follow-up
Gen. Dir for Guidance & Training
Teachers Institutes Dept.
Junior Colleges Dept.
Test & Distribution Dept.
Follow-up Dept.
Educational Guidance Dept.
Educational Training Dept.
Gen. Dir. for Planning & School Services
Gen. Dir. for School Supplies
School Services Dept.
School Planning Dept.
Textbooks Dept.
Sup. & Audio Visual Aids Dept.
Gen. Dir. for Designing & Developing Curricula
Gen. Dir for Educational Technology
Gen. Dir for Educational Research
Curricula Design Dept.
Curricula Develop. Dept.
Designing Dept.
Production Dept.
Studies Dept.
Educational Documents Dept.
Gen. Dir. for Students Services
Gen. Dir. for Counselling & Guidance
Gen. Dir. for Students Activities
Gen. Dir. for School Health
Examinations & Records Dept.
Nutrition Dept.
Counselling Dpt.
Curricula Develop. Dept.
Cultural Activity Dept.
Scientific & Literary Dept.
Sport & Social Activity Dept.
Technical & Voc. Activity Dept.
Health Units Dept.
Medical Supplies Dept.
Educational Districts
Admin. = Administrative
Ext. = External
Com. = Communication
Fin. = Financial
Cult. = Cultural
Gen. = General
Dept. = Department
Sect. = Secretariat
Develop. = Development
Sup. = Supplies
Dir. = Directorate
Voc. = Vocational

Figure 2.2 Organizational Plan of the Ministry of Education
Source: Ministry of Education, Center of Statistical Data and Educational Documentaion, 1996.

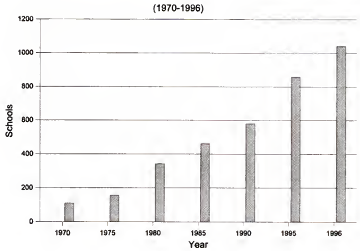


FIGURE 2.3 GROWTH OF SECONDARY SCHOOL BUILDINGS FROM 1970-1996.

Students in the secondary schools study a general curriculum for the first year that is the 10th grade, and then have a choice of four areas of emphasis for the remaining two years:

1. Religious and Arabic Sciences;
2. Administrative and Social Sciences;
3. Natural Sciences; or
4. Technical Sciences.

Students who obtain high grade point averages in mathematics and physical sciences at the 10th grade level are encouraged to enroll in one of the science programs for the 11th and 12th grade. The secondary stage curriculum, as of 1996, administered by the Ministry of Education is shown in Table 2.3.

TABLE 2.3 REGULAR SECONDARY STAGE CURRICULUM, SUBJECTS AND HOURS PER WEEK, (MINISTRY OF EDUCATION, 1996).

Subject Areas	**Courses**	**General Program**	**Religious & Arabic Sciences**		**Administrative & Social Sciences**		**Natural Sciences**		**Technical Sciences**	
		Grade	**Grade**		**Grade**		**Grade**		**Grade**	
		10	**11**	**12**	**11**	**12**	**11**	**12**	**11**	**12**
Islamic Studies	Holy Qur'an	1	3	3	2	2	1	1	1	1
	Quranic Exegesis	1	2	2	1	1	1	1	1	1
	Islamic Traditions	1	2	2	1	1	1	1	1	1
	Islamic Theology	1	2	2	1	1	1	1	1	1
	Islamic Jurisprudence	1	3	3	1	1	1	1	1	1
	TOTAL	5	12	12	6	6	5	5	5	5
Arabic Studies	Grammar	2	3	3	2	2	2	2	2	2
	Rhetoric	0	2	2	0	0	0	0	0	0
	Literature	2	2	2	1	1	1	1	1	1
	Reading	1	1	1	1	1	0	0	0	0
	Composition	1	1	1	0	0	0	0	0	0
	TOTAL	6	9	9	4	4	3	3	3	3
Administrative Sciences	Administration	0	0	0	2	3	0	0	0	0
	Economics	0	0	0	1	1	0	0	0	0
	Accounting	0	0	0	2	2	0	0	0	0
	TOTAL	0	0	0	5	6	0	0	0	0
Social Studies	History	1	1	1	2	2	0	0	0	0
	Geography	1	1	1	1	1	0	0	0	0
	Psychology	0	1	0	1	0	0	0	0	0
	Sociology	0	0	1	1	1	0	0	0	0
	TOTAL	2	3	3	5	4	0	0	0	0
Sciences	Physics	2	0	0	0	0	4	4	Science and Technical Sciences	
	Chemistry	2	0	0	0	0	4	4		
	Biology	2	0	0	0	0	4	4		
	Earth Science	0	0	0	0	0	1	1	0	0
	TOTAL	6	0	0	0	0	13	13	14	14
Mathematics		5	0	0	4	4	6	6	5	5
English		4	4	4	4	4	4	4	4	4
Computer		1	1	1	1	1	1	1	2	1
Library & Research		1	1	1	1	1	0	0	0	0
Physical Education		1	1	1	1	1	1	1	1	1
Activities		1	1	1	1	1	1	1	0	0
TOTAL HOURS PER WEEK		32	32	32	32	32	34	34	34	33

The school year consists of two semesters, each of which is twenty weeks long, including a two week examination period. Class periods are forty-five minutes long and weekly schedules vary between a total of thirty-two and thirty-four periods, depending on grade and area of emphasis.

Secondary school buildings

Educational buildings in the Kingdom have been through different developmental stages in the past century. In the early days, schooling was held inside the Mosque; however, with new subjects being introduced in all educational levels, new emerging school designs evolved to satisfy the need. New architectural spaces began to evolve and construction of school buildings followed, thereafter, a separate school design began considering all subjects taught. The design concept in these school buildings, that are built by the Ministry of Education, is based on the courtyard concept. This concept reflects and respects the environmental conditions and the social values of the region. Figures 2.4 and 2.5 illustrate the ground floor plan and first floor plan, respectively, for a typical secondary school building.

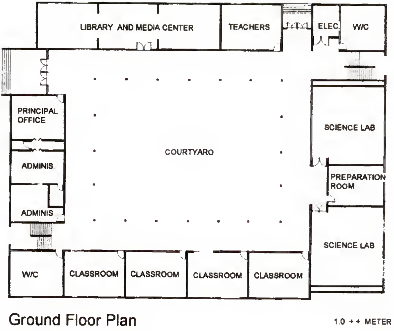


FIGURE 2.4 GROUND FLOOR PLAN OF AN EXISTING SECONDARY SCHOOL FACILITY.

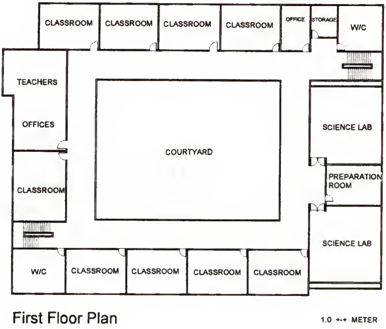


FIGURE 2.5 FIRST FLOOR PLAN OF AN EXISTING SECONDARY SCHOOL FACILITY

A recent project that is being implemented by the Ministry, started to cover some of the courtyards with skylight to improve the internal environment of school buildings, protecting the students from the harsh desert climate of high temperatures and sand storms. This tremendously improved the courtyard conditions, therefore making it more usable. Figure 2.6 shows a view of a typical courtyard.

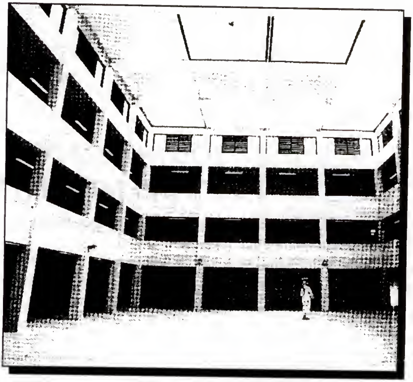


FIGURE 2.6 VIEW OF A TYPICAL SCHOOL COURTYARD.

Secondary school buildings are either two or three floors depending on the number of classrooms needed for each area in the different provinces. Figure 2.7 shows one of the school buildings from the outside.

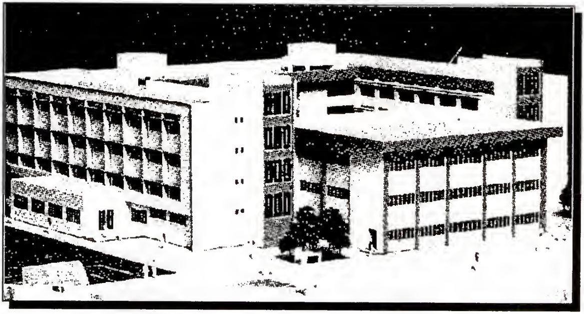


FIGURE 2.7 VIEW OF A SECONDARY SCHOOL BUILDING

Both the increase in enrollment in the various educational facilities and the increase in other supporting educational services are crucial indicators of their importance in the eyes of the Kingdom. Increased enrollment and increased educational services result in an increase in the budget allocated to education that is the basis of social developments that will affect the overall development of the society. The Five-Year Development Plan is designed to fulfill increasing educational demands.

Regional and Urban Development

During the last two decades, significant changes have occurred in the settlement structure, from land use patterns to living standards in the Kingdom. Due to the vast size and diverse geographical distribution of population and natural resources, however, the extent of these changes has not been uniform throughout the country. For this reason, the regionalization of planning has become an essential tool for studying regional phenomena and for proposing corrective solutions where necessary, as well as for exploiting various resources in the regions and for expanding public services in rural areas.

During the Fifth Development Plan period, 1990-95, the five planning regions were replaced as spatial references for planning by 13 provinces which differ from one another by a host of geographic, demographic and economic factors. The new regions have their own administration and councils that are essential prerequisites for the system of planning and improving the educational administration in the schools. Figure 2.8 shows the map of Saudi Arabia with its 13 new administrative areas.

With the issuance of the "System of Province", the institutional foundations have laid for coordinated regional and sectoral planning within the region itself, thus assuring that an equitable and efficient distribution of investments and public services can be achieved more effectively. Table 2.4 classifies each of the 13 provinces with its total number of schools,

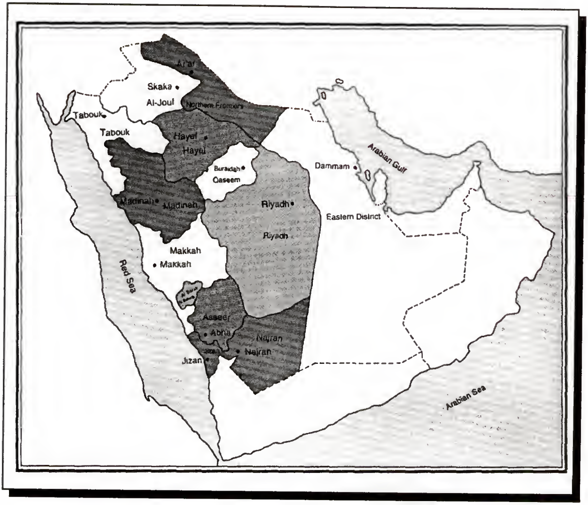


FIGURE 2.8 MAP OF SAUDI ARABIA SHOWING THE NEW ADMINISTRATIVE AREAS, (MINISTRY OF PLANNING, 1990).

classes and students. Regional development bodies are being entrusted with the task of determining their own development objectives, programs and priorities within the appropriate framework.

TABLE 2.4 NUMBER OF SCHOOLS, CLASSES, AND STUDENTS FOR BOYS AT THE 13 DIFFERENT ADMINISTRATIVE AREAS FOR 1996
(Source; Ministry of Education, 1996)

Administrative Areas	SCHOOLS			CLASSES			STUDENTS		
	Elementary	Intermediate	Secondary	Elementary	Intermediate	Secondary	Elementary	Intermediate	Secondary
Riyadh	972	447	190	10215	3292	1493	211385	86623	47000
Makkah	993	460	195	11197	3825	1828	241441	101626	53830
Medinah	385	194	72	3643	1211	517	75954	30330	14979
Qasim	389	164	68	3312	955	405	55711	21542	10143
Eastern	510	283	136	6303	2347	1117	152008	67066	33590
Asseer	801	329	136	5804	1736	875	95329	40415	22780
Hayel	266	102	45	2005	496	226	30784	11624	5610
Tabouk	153	75	27	1504	430	189	31767	11453	5683
Baha	262	92	37	1719	474	235	24459	10755	6139
North Frontiers	75	32	13	754	222	107	16674	5678	3012
Jouf	105	53	25	1020	348	157	21100	8544	3913
Jizan	463	215	77	3982	1065	405	74686	24086	10726
Najran	124	55	22	1228	364	162	26811	9727	4544
GRAND TOTAL	5498	2501	1043	52686	16765	7716	1058109	429469	221949

Telecommunications

Telecommunications services in Saudi Arabia have made a significant contribution to economic and social development over the last decade, providing a wider range of communication services. Demand has increased for the introduction and application of new telecommunications technologies, such as an Integrated Services Digital Network (ISDN), digital mobile communications, broad band digital leased circuits, video conferencing and electronic mail. Therefore, the overriding concern of future years will be the satisfaction of this growing demand for existing and new telecommunications services (Ministry of Planning, 1995).

Modernization and expansion broadly define the two challenges facing the telecommunication sector at the start of this Sixth Development Plan, particularly with respect to the long distance network (with its requirements for digitization and the installation of optical fiber cables, digital microwave facilities and the upgrading of satellite equipment) and the exchanges, where existing hardware and software need to be replaced. Such modernization and expansion of the telecommunication infrastructure in the Kingdom by the Ministry of Posts, Telegraphs and Telephones (MOPTT) will maximize the benefit when applying the latest instructional technology in the educational sector.

Future of Education

In any culture, as a society grows, its demand for educational facilities will also increase. The Saudi Arabian Ministry of Education is building new schools throughout the country in order to cope with this tremendous increase in demand. However, instructional technology implementation in these designed educational spaces is not being considered to optimize the learning environment. Such technology as distance interactive video classrooms, computer labs and collaborative multimedia workstations are dependent on adequate planning and spatial configuration. More importantly, designing schools of the future is no longer the same.

Summary

This chapter had covered the educational system in the Kingdom and its major developments throughout the history of the Ministry of Education. Moreover, one of the most constructive developments was the new 13 province system. With the implementation of the new provinces in the Kingdom, it is now more efficient and effective to apply a strategic plan for instructional technology that ensures superior achievement in the educational system. It can be concluded that three levels of hierarchy occurred for strategic planning:

1. National, where various economic and administrative functions relevant to the whole country are available and where highly specialized services are provided, this is where the Ministry of Education stand;
2. Regional, where less specialized administrative and service functions are performed for a number of local centers;
3. Local, where instructions and services that are needed on a frequent (daily) basis and serve a number of nearby villages.

This chapter has investigated and examined the Saudi Arabian educational system, its potentials, capabilities and limitations. This will lead to the understanding of how the study will frame the implementation of instructional technology in secondary school buildings, therefore, redefining and enhancing the learning environment for future generations. It can be said that the Kingdom's educational system is in a state of change. With its potential resources and wise decision making in the educational sector, there are opportunities to change and see advancements in school facilities, therefore, going into the 21st Century with confidence as a world class provider of educational facilities.

The next chapter will look at the latest literature review on instructional technology and its application in the educational sector. Some of the important implementations and limitations are also discussed.

CHAPTER III
CURRENT TRENDS IN INSTRUCTIONAL TECHNOLOGY

> The media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbook and blackboard
>
> Commission on Instructional Technology, 1970

Introduction

Technology is changing the way we design our buildings and is making a significant impact upon the design of educational facilities. The traditional learning environment in schools are in a state of transition, as instructional technologies and communications improve, therefore, enhancing the design of classrooms. According to Herman (1995), in his new vision of what schools should be for the 21st century, we are in a crucial time that many school buildings in this country are in need of major revision. Schools have passed their point of effectiveness and they should be redesigned to utilize and enhance the new technological advancements to improve the learning environment.

Bordwell and Gray (1996) emphasize that public education must start to harness the power of 21st century tools in order to meet the demands of this new era. They also contends that blackboards and chalk alone will not do it anymore. As Frank B.Withrow (1997) describes in his article "Technology in Education and the Next Twenty-Five Years," if present trends continue, it seems not unreasonable to expect that digital technologies will have an impact on our classrooms proportionate to that of writing and the printing press. Most importantly, he adds that technology will make high-quality education available to everyone in schools.

Designing educational facilities to support technology planning is critical, because it requires serious attention to the interior layout of the space. A space should best support the needs of the required activities as a whole. Laying out individual spaces successfully requires a full understanding of the whole integrated system in order to achieve a comprehensive strategy, thus; the spaces perform within the needs of the users in terms of educational philosophy, social content and environmental aspects.

This chapter concentrates on how instructional technology is transforming the planning of educational facilities, especially educational spaces in schools and the community system. Furthermore, multimedia and telecommunications are enriching and reforming the learning environment in our schools and communities. Therefore, educational facilities are in a state of challenge to move into the next century and incorporate state-of-the-art technology.

Overview

The application of technology requires an appropriate work space to be integrated into the designs for new schools and modified in existing facilities. Particular attention needs to be given to work surfaces, display areas, screen location and dimension, lighting conditions, storage for materials and models, and the security and safe use of tools. Work areas will need to be relatively spacious in terms of square area per student.

During the last few years much of the attention in the development of technology focused on the hardware and software, and how to develop ways to enhance the users learning capability. In contrast, little attention has been given to the planning and design of the environments for communication and learning. Architects must know how to design for new technologies such as multimedia, teleconferencing, audience response systems and virtual reality simulations; but they must also consider the kinds of social, cultural and environmental aspects they wish to accommodate (Gayeski, 1995).

Furthermore, instructional technology will improve the quality of learning in the public school system dramatically in three ways (McCain, 1996):

1. The learning process, which presently is based on the transference of knowledge by a teacher, will shift toward a student-centered process with the teacher guiding the student's personal exploration of the subject material.
2. The universe of available subject material will extend beyond the resources of the classroom; information sources (Internet), previously inaccessible, can materialize in a few keystrokes.
3. Affordable technology will engage the minds of many who would otherwise fail to be captured by the excitement of learning. The learning process becomes student driven rather than teacher driven, fashioning the teacher a facilitator.

Instructional Methods

In our technology age, teachers are no longer limited to the boundaries of the classroom . The entire school can now access unlimited knowledge and information via technology. (Hossain, 1996) illustrates that the concept of traditional instructional technology is based on linear and hierarchical relationships. However, emerging instructional technology presupposes non-linear and symbiotic relationships. Table 3.1 illustrates a total restructuring of the learning environment.

TABLE 3.1 MERGING INSTRUCTIONAL TECHNOLOGY AND DECONSTRUCTION OF TRADITIONAL PEDAGOGY, (ELMORE AND JAFARI, 1995).

	Traditional Instructional Method	**Emerging Instructional Technology**
TEACHER ROLE	Expert	Facilitator
STUDENT ROLE	Passive Recipient	Active Collaborator
INSTRUCTIONAL EMPHASIS	Facts, Rote Learning	Critical Thinking
EVALUATION OF LEARNING	Retention	Assimilation and Interpretation of Facts
TEACHING METHOD	Drill and Practice	Interactivity and Collaboration
ACCESS TO KNOWLEDGE	Learning Limited Access to Knowledge/ Dated Materials	Unlimited Access to Knowledge\Information via Technology

Teleconferencing is two way communication between two or more separate geographical areas, all the participants will see and hear the various sites. Therefore, one must be an active participant versus passive (Lochte, 1995). This type of setting requires close attention to designing it's comfort and the effectiveness of the space to be utilized for prolonged time periods, whether it be students, teachers or/and administrators.

Physical Infrastructure

This new era in technology is dominated by interactive communication, a factor that will change our physical setting in schools. Interactive communications refers to the ability of individuals (e.g., student, teachers) to have immediate access to information found at different geographical locations. This information can take any shape or form, from retrieving text, graphics or full motion video from a remote site to seeing and talking to individuals located across the country or the world. It is becoming more prevalent that instruction will turn increasingly to these technologies, and functioning effectively in an interactive communications environment will be a key element to educational success. However, the need to develop a communications network and physical infrastructure that contains the cabling, wiring and equipment required to support interactive communications technology within and between schools is recently gaining the attention it deserves. Without such an infrastructure, the potential of interactive communications cannot be achieved.

Current Trends

The need to create a physical infrastructure capable of supporting the applications of technology that will provide students with the necessary technology is elicited directly from several important current trends. First, all forms of technology are being driven by the necessity of connecting and communicating with other forms of technology. Second, the information superhighway is both highlighting the need for increased connectivity and, therefore, increasing awareness of newer forms of instruction. Finally, greater use of teleconferencing (two-way interactive video) also calls attention to the need for a district-wide physical infrastructure to support the current technology.

Equipment that worked independently of other pieces of equipment, or stood alone, was once standard in schools. A single computer could be added to a classroom with little impact on other equipment. Although systems that connect various pieces of equipment within a classroom or school known as a LAN (local area network), have been available for some time, their high cost and unreliability has resulted in few of them being promoted in schools throughout the Kingdom. But, as LANs have become less costly and easier to use, they are being installed in more schools today.

As LAN connects different equipment within a certain school building or classroom, a WAN (wide area network) provides connections among the various schools in a community, district or provinces. It is the WAN that allows schools to access centralized data either at the district, state or government level. Although there are major technological differences between LAN and WAN networks, they share remarkable similarities. Most noteworthy is that they are both growing rapidly in school districts. As users of both types of networks have become increasingly technologically literate and more dependent on these technologies, they have made increased demands on both systems. Both LAN and WANs must be supported by the appropriate physical infrastructure to be effective and sufficient.

Another area of importance and interest is in the field of teleconferencing or two-way interactive video, in which teachers and students at different locations can see and hear each other immediately and also see the students in both locations. Widespread application of this technology can now be seen at some universities and will eventually spread into all levels of education; requiring that the appropriate physical infrastructure be in place.

Design Issues in the Classroom

Designing a technology friendly classroom can be divided into three major categories. First, environmental design, which is closely related to the architect, covers areas such as comfort factors, projection screens, writing boards, lighting systems, acoustics and ergonomics. Second is the area of technology design factors, which focuses on the integration of audio, video, optical, maintenance, security and computer technologies. Third is the interface design, which covers areas of ergonomics and human interaction with the operation of the technology, (Elmore, 1995).

Display surfaces may be classified into projected screens as images or monitor screens. Projection screens are plain flat white surfaces that scatter reflected light in all directions, yet they are not designed to be viewed beyond a 60 degree viewing angle around the perpendicular surface of the screen, as the projected image would then appear compressed or distorted, (Utz, 1992).

Screen size in relation to the dimension of the room is a primary consideration in designing classrooms, therefore the rule of two-by-six would apply as a rule of thumb. This means that no viewer should be seated closer to the screen than two screen widths or farther away than six screen widths, (Heinich, 1996). A square screen is always more preferable due to its flexibility in showing rectangular images as well as square images. Figure 3.1 illustrates an appropriate screen size for a typical size classroom according to the two-by-six rule.

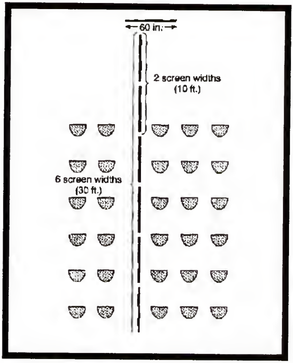


FIGURE 3.1 TYPICAL SIZE CLASSROOM ILLUSTRATING THE TWO-BY-SIX RULE.

To avoid obstruction of the view screen height should be adjusted so that the bottom of the screen is above head level. The minimum height for the bottom of the screen must be at least 4 feet above the floor to prevent head interference (see Figure 3.2).

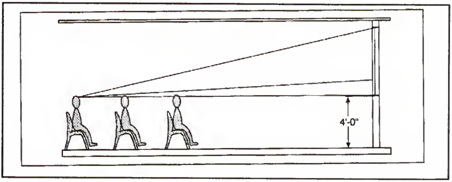


FIGURE 3.2 SCREEN HEIGHT SHOULD BE ABOVE HEAD LEVEL.

Some design guidelines should be followed in locating the monitor to be viewed by a class group . In addition to the distance from the screen, viewing angles (both up-and-down and side-to-side) should also be considered. Monitor placement should require no more than 30 degrees of head tilt, providing a comfortable viewing angle for a group sitting in a classroom, and the side-to-side angle should not exceed 45 degrees from the center line to provide comfortable viewing. Figure 3.3 illustrates the recommended monitor placement and seating distances for viewing (Heinich et al, 1996).

Another display surface gaining popularity in presentations is the electronic whiteboard, which takes anything drawn or written on its surface and displays it on a computer screen. Once reserved for high-priced corporate offices, whitboards now come in sizes suited for small classrooms. A self-contained interactive whiteboard, the new rear projection SMART Board from SMART Technologies Inc. (Appendix A), allows users to run and control applications and annotate images with the touch of a finger. Because the LCD projector sits behaind the whiteboard, the instructor casts no shadows in front of the information presented.

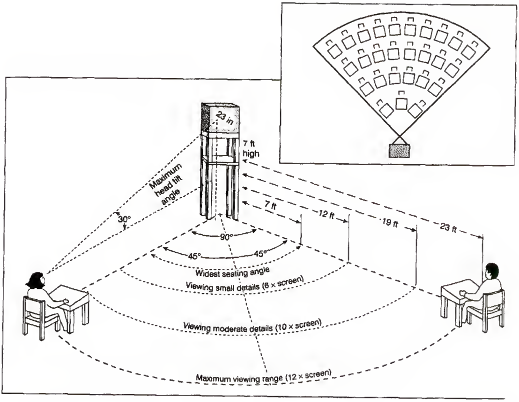

23 in
7 ft
high
Maximum
head tilt
angle
30°
7 ft
12 ft
19 ft
23 ft
90°
45°
45°
Widest seating angle
Viewing small details (6 × screen)
Viewing moderate details (10 × screen)
Maximum viewing range (12 × screen)

FIGURE 3.3 RECOMMENDED MONITOR PLACEMENT AND SEATING DISTANCES FOR VIEWING.

Technological Design

When designing a classroom that emphasizes technological applications, there are certain specifications and approaches that can readily lead to the desired goal of the client. (Elmore and Jafari, 1995) discusses the advantages and disadvantages of these significantly different approaches in developing and supporting an electronic classroom. Table 3.2

summarizes possible approaches and their advantages and disadvantages.

TABLE 3.2 APPROACHES TO PROVIDING TECHNOLOGIES IN THE CLASSROOM

APPROACH	ADVANTAGES	LIMITATIONS
Portable Installation	* Technology is instantly available and encourages use * More technology can typically be launched	* High capital investment as a campus-wide solution * Dedicated room and diverse needs may limit access to technology
Portable Technology	* Cost-effective and practical * Excellent interim solution until more powerful, fully digital notebook system are developed * Can be made available in any classroom * An easy solution for integrating and customizing specialized multimedia systems	* Transportation, security and logistical issues must be resolved * Repair and maintenance may be difficult for some system
Electronic Distribution	* Technologies can be shared among many users * Workstations can access resources from anywhere on campus * Systems can search databases and deliver text, graphics , images and motion video * Less space is required in classrooms * Less time and money is spent on mechanical chores of delivery	* Central campus planning and funding is essential * Extremely costly initial investment, especially if existing networks are inadequate * Not an overall solution for computer and digital multimedia applications at this time * Copyright issues not resolved for material stored and delivered electronically

Classroom Design Model and Layout

Classroom design has not changed during the last few decades. The most predominant feature of any classroom, in any educational facility, is rows of tables and chairs facing the blackboard. However, with the rapid development of technology and communication equipment, planning of and laying out the hardware in a classroom setting is most critical. Once the electric and network cable has been installed, it is difficult and expensive to move the equipment (Daly, 1994).

Workstations may be arranged in an infinite variety of layout, depending on how many computers are to be used in the classroom and for what purposes. Figures 3.4 through 3.6 illustrate layouts with a different number of computers being used in different ways (Plans developed by Interactive Learning Systems, Inc., Cincinnati)

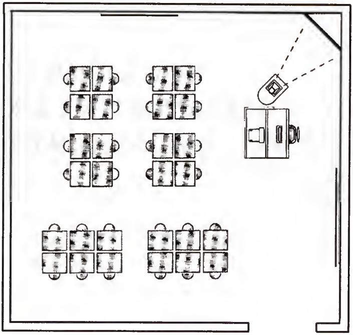


FIGURE 3.4 A SINGLE-COMPUTER CLASSROOM WITH COMPUTER PROJECTION USED FOR LARGE GROUP VIEWING.

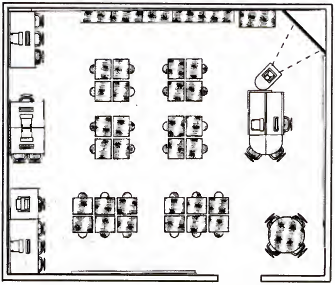


FIGURE 3.5 AN ELEMENTARY CLASSROOM WITH FOUR COMPUTERS ALONG THE WALL USED FOR INDIVIDUAL AND SMALL GROUP STUDY.

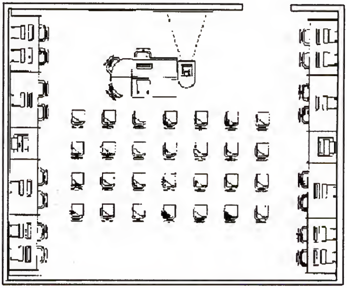


FIGURE 3.6 A SECONDARY SCHOOL CLASSROOM WITH 12 COMPUTERS AND 2 PRINTERS USED INDIVIDUALLY.

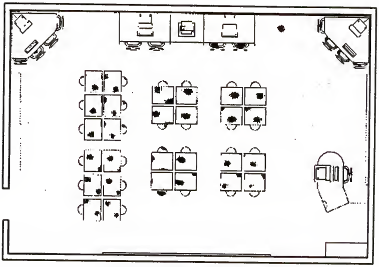


FIGURE 3.7 A MIDDLE SCHOOL CLASSROOM WITH FOUR COMPUTERS ARRANGED IN CLUSTERS FOR COLLABORATIVE LEARNING.

Architectural guidelines for designing educational facilities are changing in a dynamic response to the transforming world of technology and educational philosophy. When designing educational facilities for instructional technology an architect should keep in mind these considerations (Daly, 1994):

1. Place the workstations in clusters to allow for easy observation of students.
2. Place the workstations near the wall, when possible, to allow cable and electric power to be supplied along or in the wall.
3. Place workstations in an area of the room that highlights their importance as instructional tools, but that does not distract other students who are not using the computers.
4. Place workstations so that they do not block board space. Try to install white boards in an effort to eliminate chalk dust.

5. Place workstations so that they are away from the heating units. Place the workstations away from windows so that you avoid glare on the screen.
6. Place the teacher station in an area that allows the teacher to use the unit, use a projection panel and yet see all of the students.
7. Place student workstations so that students can easily see their individual workstation as well as the board and the projection screen.
8. Place student workstations in such a manner that students can easily walk through rows without disturbing other students, and in a manner that allows access for physically challenged youngsters in wheelchairs or on crutches.

See Figures 3.8 through 3.11 for more possible layouts of individual classrooms and labs using a distributed network.

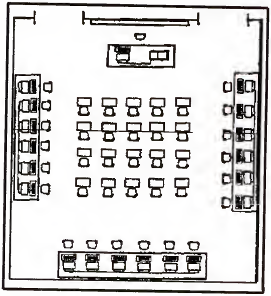


FIGURE 3.8 LAYOUT OF A CLASSROOM USING COMPUTERS ALONG THE PERIPHERAL.

In Figure 3.8 the layout provides for computers along the peripheral walls, and for large group instruction at desks facing the board and projection screen. A computer workstation and desk is provided for each student. This layout requires a large room. However, Figure 3.9 below, provides for large group instruction for an entire class, and for small group or individual instruction at tables and computers along the wall.

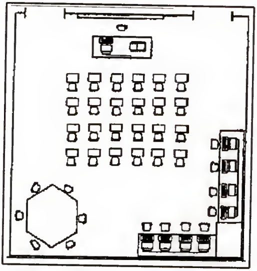


FIGURE 3.9 A COMBINATION OF TRADITIONAL LAYOUT AND COMPUTER LAB

However, Figure 3.10 requires that all workstations face forward, so that students are able to see the board, projection screen and their own computer screen without moving their chairs. It allows the teacher to move to the rear of the classroom and view all student screens in unison, it's most beneficial when the room is long and narrow.

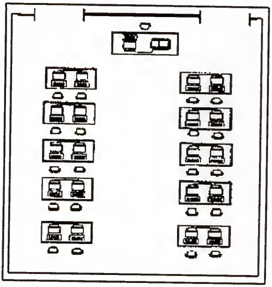


FIGURE 3.10 ILLUSTRATES A TYPICAL WORKSTATION COMPUTER LAB.

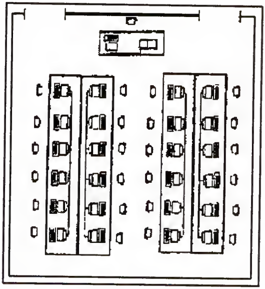


FIGURE 3.11 CLASSROOM LAYOUT WITH BACK TO BACK.

Figure 3.11, illustrates a layout that locates all units back to back. Students can see the board and projection screen by turning approximately 45 degrees toward the front of the room which could be uncomfortable.

Community Involvement

Some of the most effective and significant approaches to integrate a community and the development of technology in our schools involve strategies and plans for seeking out involvement that develop ownership in the change process:

1. Schools should collaborate and develop plans that involve the entire community.
2. Schools should create a system that connects sites throughout the different areas.
3. Schools, community centers, libraries, museums, colleges and private homes sharing a network becomes a very exciting educational and communication forum. Therefore, learning takes place anywhere and anytime in the information age. Figure 3.12 illustrates a network of different physical spaces that can be connected.
4. School councils and related community groups could work together to establish, supervise and maintain the rapid development of technology and the policies governing it.
5. Business and industry usually acquire technologies before schools do. Therefore, schools should seek to establish a connection between school and work, and tap into industry expertise.

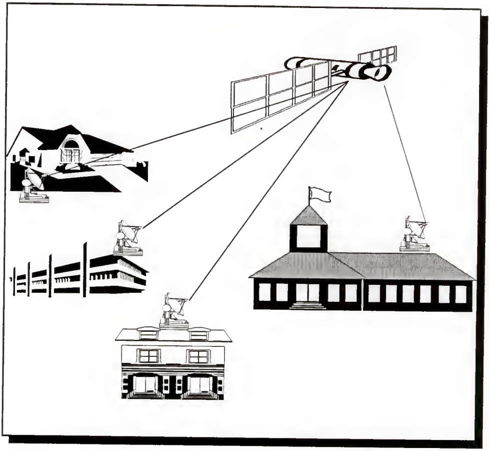


FIGURE 3.12 SATILLITE NETWORK CONNECTING INTERNET FOR DIFFERENT PHYSICAL SPACES THROUGHOUT THE COMMUNITY.

Conclusion

If schools are to maximize the benefits of community collaboration they should offer technology learning programs during non-school hours that are staffed and funded by the community. These classes should be open to any community member, adult or child. Schools should seek out community volunteers who have technological expertise. These volunteers can act as tutors and/or teachers' aides to help monitor a technology classroom or center. Schools may consider creating a new position, a community technology communication coordinator, who plans and manages school and community relations and builds a community support system.

Planning for the next millennium is becoming increasingly challenging to the architect and planner. As technology improves and rapidly changes, it is expected that designs and planning for schools and communities change accordingly. We live in a dynamic world, and to be a leader in the application of state-of-the-art technology in our educational system we must reconsider the way schools are designed. Most important is developing a strategic plan that can serve as a comprehensive plan for all districts, which will recommend a general direction for the metamorphosis our schools.

CHAPTER IV
INTEGRATION

Introduction

Saudi Arabia today is a country of change. This change is happening faster than recorded in any other time or place in the world. Saudi Arabia is a country of great tradition and conservative social values, and it is attempting to cope with the overwhelming tidalwave of technological advancement in all fields of knowledge. The challenge facing the Kingdom's leaders has been to find ways of channelling this and integrating tremendous development in communications and technology into its social fabric without harming it.

The multidimensional socioeconomic changes witnessed by the Saudi society entail the process of development and restructuring of the educational system. This is remarkably observed in the persistent and continuous increases in the budget allocations for education, and the resultant implementation of extensive educational projects. In 1996, the government had allocated 20% of its fiscal year budget to education, making it the second priority in spending.

The Kingdom is keen on developing education through its Five-Year Development Plans along the following objectives:

1. Promoting the efficiency of the education system.
2. Ensuring that the education system shall fulfill the religious, economic and social objectives sought by the Kingdom of Saudi Arabia.
3. Providing for the educational building and facilities.
4. Decreasing the illiteracy rate among the Saudi male and female citizens.
5. Raising the standards of awareness, efficiency and effectiveness of the professional and administrative performance in the educational institutions to improve the standard and contents of the educational process.

(Ministry of Education, 1996)

Current Planning

To take advantage of the vast resources of the Internet, King Abdulaziz City for Science and Technology (KACST), with other academic institutions in Saudi Arabia, is taking the lead in introducing the Internet to local communities through an Internet pilot project. SaudiNet is the proposed name of the on-going IP network in Saudi Arabia. The main goal of the project is to provide the foundation for SaudiNet through identifying local technical requirements and other resources needed for a locally-run Internet. In addition, SaudiNet aims to establish a local infrastructure, and then link its infrastructure to the World Wide Web (WWW). The experience gained in this project will guide the overall planning, design and implementation of SaudiNet, (KACST, 1996).

Social Acceptance and Integration

While the Internet is still not commercially available in the Kingdom, the Saudi society is preparing to learn about the many benefits that can be achieved when it is introduced. Perugini (1996), states that whether or not the technology is accepted or rejected will depend largely on the "economic, sociological and political features" of the society in general, including determination of whether the technology is compatible with that society's values.

Seminars about the Internet are being introduced by different government agencies and private sectors to university facilities and students around the Kingdom. In May of 1997 the Saudi Computer Society in Riyadh (ladies department) hosted a seminar introducing the Internet and the WWW to members and ladies from universities and students majoring in computer application/technology. These seminars are pivotal steps in introducing this technology to Saudi society.

Minister of Education Dr. Muhammad Al-Rasheed opened the Saudi Computer and Office Technology 1997 Expo in Riyadh in March of 1997. The four-day exhibition attracted nearly 100 local and international companies. Speaking after opening the exhibition, the Minister called for intensified efforts to introduce computer education at all levels in Saudi schools.

Computer sales have become a booming business in the Kingdom. There are already more than 500 computer stores and showrooms in Riyadh alone, which sell approximately 2,500 Personal Computers (PCs) daily. Sales nationwide are estimated at 10,000 units per day, generating revenues around $10.66 million (Computer Expo, 1997).

In a study on the relationship between technology and social values, Theodore J. Kowalski (1989) observed how the values held by a society affect the technology which that society produces, and how that technology, in turn, affects a society's values. He believes that the effect of any new technology on society values is circular, and that it is a society's values which bring about the creation of the technology in the first place. Once adopted, the technology itself becomes the catalyst for the changes in values, which then drive the creation of still other technologies (Baier and Rescher, 1969). Gordon developed the concept of a feedback mechanism that exists between values and technology, illustrated in Figure 4.1.

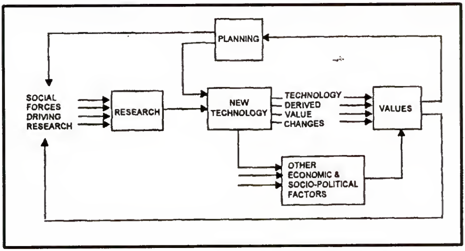

PLANNING
SOCIAL FORCES DRIVING RESEARCH
RESEARCH
NEW TECHNOLOGY
TECHNOLOGY DERIVED VALUE CHANGES
VALUES
OTHER ECONOMIC & SOCIO-POLITICAL FACTORS

FIGURE 4.1 FEEDBACK BETWEEN VALUES AND TECHNOLOGY

Educational Space

The traditional notion of the classroom is that of an enclosed space in which the teacher, standing at one end, can readily address a group of students. Such a design, of course, stems directly from the idea that education centers on what the teacher does and says. Figure 4.2 illustrates a typical plan of a classroom 6 X 8 meters.

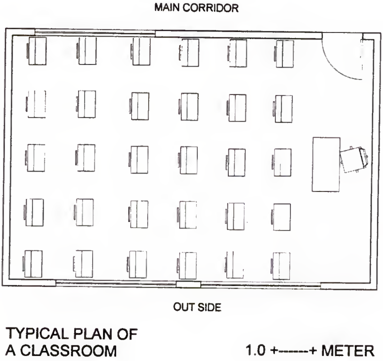


FIGURE 4.2 TYPICAL PLAN OF A CLASSROOM IN A SECONDARY SCHOOL

The new concept of the teacher as facilitator and students as learners demands a different approach. Thinking about design must start with the needs of the learners, not of the teacher. Thus, the classroom must be thought of not as a space for communication between the teacher and a group of students, but as a collection of workstations.

The layout and physical setting of a "built environment" functions in three distinct ways to support the behavior and response of the user (Moleski and Lang, 1982):

1. The physical setting provides the physical elements required to sustain the physical states necessary for an individual to satisfy his or her needs.
2. The physical environment goes beyond containment to provide physical facilities and spatial arrangements that help specific activity patterns and discourage other activities.
3. The physical arrangement generates and maintains mental and emotional states necessary for need satisfaction by fulfilling symbolic, aesthetic and ambient functions.

Different transitioning models of instructional technology are illustrated in Figure 4.3, the higher the model the more integrated the technology plan with the school system.

Increasing Instructional Technology

Isolated Computer Workstation	Single Computer Laboratory	Clusters of Networked Computers in All Classrooms	Networked Computers at Each Student's Desk
MODEL 1	MODEL 2	MODEL 3	MODEL 4

Increasing Expenditure Cost

FIGURE 4.3 TRANSITION THROUGH INSTRUCTIONAL TECHNOLOGY MODELS

Does Technology Make a Difference

Many researchers suggest that technology makes a difference in our educational system. In one particular case, Las Cruces board members questioned spending $1 million of a $3 million bond issue on technology and how this spending would make a difference to the students' education. The board adopted a mission statement that promotes productivity in education through the planned use of technology to address critical education issues. School districts must understand how technology can make schools more effective and they must establish polices to guide their investment (Doyle and Levinson, 1993).

Blackstock Junior High School in Oxnard, California, is one of a rapidly growing number of computerized school's across the United States. Rescigno, the district superintendent, said that "some studies prove there is a strong relationship between the use of technology and student achievement" (Hoffman, 1995, p.117).

Doyle and Levinson (1993) suggest seven steps to cultivate productivity in implementing technology to work to increase productivity in schools, they are as follows:

1. Be sure measurable educational outcomes, such as improved achievement or lower dropout rates, are part of the district's technology proposals.
2. Allocate 25 percent of the district's technology budget for staff development and teacher training, the key to increasing outcomes.
3. Create a long-term infrastructure plan for your entire school district that will meet the needs of the district and of individual schools over the next decade.
4. Make larger technology investments in new schools, linking the technology

to differentiated staffing, more effective curriculum and decreased administrative costs.

5. Establish district-level teams to support school-based efforts in curriculum, staff development, assessment and technology.
6. Forget business as usual. Introducing technology to increase productivity means changing teachers' roles, the instructional process and management procedures.
7. Pay attention to implementation. How schools adapt to new technology as it is put in place will make or break productivity. Projects must constantly be adjusted as they are implemented.

These steps are crucial issues for the district to take into consideration when planning for technology. Most importantly, the design of the school building should support these steps.

Technology, will it Change Education

New teaching and learning technologies such as computers and electronic notebooks are already changing the way we learn, and they will continue to evolve. For example, one compact disk (CD) can hold an easily accessible Encyclopedia. In other words, a student can carry a small library in one hand. Some of this new technology will require special wiring and furniture, and school architecture will have to accommodate it. Architects will have to remember, however, that computers, video display and notebooks are tools, not ends within themselves. These are new kinds of "books" that will require proper handling. The rapid spread of such technology, however, raises an important question. Will students learn more because of technological advances? That is what we expect.

Influence of School Design

School design has an impact on students and staff learning mechanisms and attitudes. Environmental variables that influence students are: temperature and humidity; noise, light, and color; seating position and layout; design of the classroom; density and privacy; and window or windowless classroom. These variables can be used in ways that will predictably affect learning and problem solving (Knirk, 1992).

In a study by Moleski and Lang (1982), a significant relationship is indicated between the physical setting and behavior, both of which can be modified by three elements:

1. *Goal of the Organization*

   In this situation it is an educational organization which has its educational goals set by the Ministry of Education.

2. *Value of the User*

   That there must be a humanistic interpretation of the students' values and needs.

3. *Demands of the Future*

   The future demands placed on an organization by its external environment must be filtered through the beliefs of the corporate culture to establish the symbolic context of the solution.

Students in a classroom setting are often presented with visual information through televisions, overhead, projected images or computer monitors. To illustrate this visual seating and how it can influence the performance of students, lets look at a common occurrence with an elementary classroom (Figure 4.3) watching a wall-mounted instructional television.

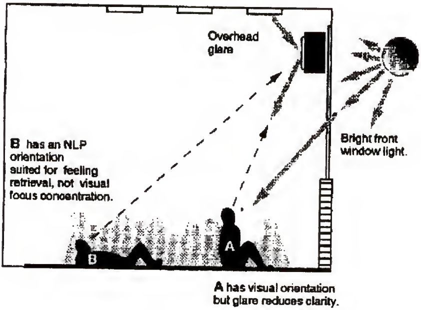

Overhead glare
B has an NLP orientation suited for feeling retrieval, not visual focus concentration.
Bright front window light.
B
A
A has visual orientation but glare reduces clarity.

FIGURE 4.4 THE EFFECT OF VISUAL ORIENTATION IN A CLASSROOM SEATING

1. Student "A" experiences bright window light, fixture glare and poor angle of incidence. Therefore, retention of information is greatly influenced.
2. Student "B" has a better situation regarding angle of incidence and glare, but his position (seating) is still reducing his focus concentration on the subject.

These two situations illustrate how the design and location of screens or monitors can have a tremendous influence on our students performance. A lower-level television, screen orientation away from the windows, with controlled overhead lighting which reduces glare and improved posture and orientation on the part of the students will substantially improve the learning potential of this educational experience.

In many situations in which projectors are used, the windows will be closed and the blinds or drapes drawn to keep light out; therefore, sufficient air flow and air cooling must be engineered to optimize learning. Due to the increased heat output by the projectors lamp (500 watt), additional ventilation must be built into areas where mediad will be used.

In another study by Freeman (1972) on personal space requirements, he assigned 126 high school students in groups of nine to either

1. small room (30 square feet),
2. moderate room (120 square feet), or
3. large room (200 square feet).

In the small room, students had just enough space to put their feet on the floor without touching anyone else. All of the rooms were as alike as possible, in terms of air conditioning for comfort, good air flow to keep body odors to a minimum and insulation to keep noise levels about equivalent; however, the density of the rooms varied. Students stayed in the rooms three hours a day for three days and worked on a wide range of tasks. Results show that there is no effect on performance due to crowding. Freeman concluded that crowding did not act as a stress that interfered with the performance of simple or complex tasks.

A major conclusion of a study conducted by ISTE (International Society for Technology in Education, Braun, 1993) states that

1. All students learn more and learn better when they access technology in an intelligently designed environment.
2. Technology is especially effective with at-risk students.
3. Teachers need training in the uses of technology in their curricula.
4. To achieve the benefits technology makes possible, we must restructure our schools in dramatic ways.

The results of these studies show how our "built environment" has a powerful influence on the success of future generations. It is time to make a change for the sake of our children.

Conclusion

Some of the ways that this instructional technology infrastructure shall benefit the students, instructors and the Ministry of Education are

1. Overcoming the traditional isolation of students, teachers and schools.
2. Enhancing the learning process of the students in any subject.

3. Enabling secondary school students in remote rural communities to receive the same educational choices as those offered in urban areas.
4. Guest speaker's who must travel between provinces or schools to give a lecture can now use the technology to teleconference from one convenient location.
5. Students can share experiment results in different locations through the use of the net.
6. Encouraging students to be active participant's in the educational process.
7. The model will enable students to learn the technology at an early age.
8. Perform collaborative work with students in other locations around the country or around the world.
9. The Ministry of Education can easily communicate with any school, or any classroom, at any time.

CHAPTER V
PLANNING AND IMPLEMENTATION

Introduction

Instructional technology today is changing the way architects design school buildings and is making a significant impact upon the design and layout of classrooms and schools. These technologies will impose new requirements on the design of every aspect of the school building (McCain,1996). The application of technology requires appropriate work spaces that have to be incorporated into the designs of new schools and modified for existing facilities. Particular attention needs to be given to work surfaces, display areas, screen location and dimension, lighting condition, storage for materials and models, and the security and safe use of tools. This chapter investigates different ways of implementing instructional technology in the current school layouts.

Current Planning

In a recent issue of Computer News Middle East (1996), countries in the Gulf Region have debated over access to certain areas of the Internet. Some countries and companies in the region would not find it commercially or politically acceptable for the Internet to be a completely wide open communication and information access network.

Figure 5.1 shows the Internet connectivity to different parts of the world.

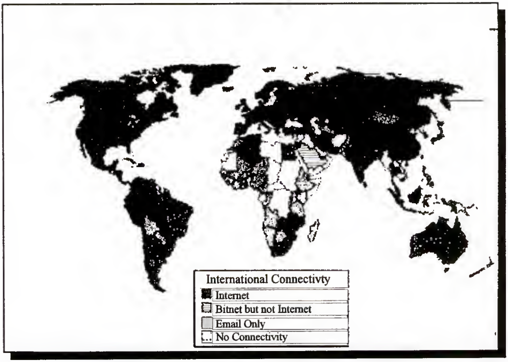


FIGURE 5.1 INTERNET CONNECTIVITY TO DIFFERENT PARTS OF THE WORLD UP TO 1996.
(Source: Internet Society, 1996)

While the Internet is still not commercially available in the Kingdom, KACST and other official government agencies are planning the infrastructure. In view of the situation, many companies are looking at options aimed at producing firewall software and hardware solutions that could restrict access to those unacceptable areas (sites) and block the movement of unauthorised data in and out of the network.

Saudi Arabia is expected to legalize the Internet in the Kingdom and allow access through King Abdulaziz City for Science and Technology, in a recent statement by the head of KACST (Saudi Arabia to allow, 1998). KACST, following a government directive authorizing funds for the project, had set up a special unit that would "supervise the whole process of linking Saudi Arabia with the rest of the world through Internet services," he said. The authorities had completed a study on how to prevent objectionable material that went against the country's religious and moral values from entering the Kingdom through the Internet.

Computer Networking

Networking originated from the need to share data in a timely fashion. A group of computers and other devices connected to other computers are called a network, and the concept of connected computers sharing resources is called networking, (Microsoft, 1996). The network depends on numerous factors of which includes:

1. Size of the institution or organization installing the network.
2. Level of security needed.
3. Amount of network traffic.
4. Level of administrative support available.
5. Needs of the network users.

For the Ministry of Education, computer networking has major advantages over isolated Personal Computer, television or conventional educational environments in the following ways:

1. They do not require fixed spaces such as classrooms or studios; therefore, instructors can teach and students can learn wherever they

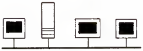
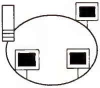
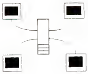
are.

2. Their use is not limited to fixed times, they are available to instructors and students 24 hours a day and share resources and enable online communication.
3. Networks provide a single infrastructure for most, if not all, school functions and services: instruction, research, communications and administration.
4. Computer networks permit individuals access to worldwide resources, thereby centering the educational process on learning rather than passive listening.
5. Reduce the need for paper to communicate.
6. Networks will prove easiest to modify as future demands dictate.

Once all regions and school buildings are networked and connected to the main server at the Ministry , the opportunities expand rapidly. Students can share their work with others around the Kingdom, or around the world, providing them access to diverse cultures and perspectives that they would not encounter in otherwise everyday experiences. Information is available on the World Wide Web (WWW) that can provide students access to materials such as scientific journals and the latest research data that would take years to be published in textbooks. A network also provides access to mentors and experts, through teleconferencing, that would not traditionally be accessible to students. As students become increasingly familiar and comfortable with the technology, they become prepared for their future after finishing secondary school. In addition to the main server at the Ministry, each Province is provided with its own server that is connected to the network.

In selecting the type of topology that is needed and is suitable in the implementation of a network throughout the Kingdom, the following table 5.1 summarizes the advantages and disadvantages of different types of topology (Micosoft, 1996):

TABLE 5.1 ADVANTAGES AND DISADVANTAGES OF THE DIFFERENT TYPES OF TOPOLOGY USED FOR NETWORKING.

Topology	**Advantages**	**Disadvantages**
Bus 	Economical use of cable. Media is inexpensive and easy to work with. Simple and Reliable. Easy to extend.	Network can slow down in heavy traffic. Problems are difficult to isolate. Cable break can effect many users.
Ring 	Equal access for all users. Even performance despite many users.	Failure of one computer can impact the rest of the network. Problem hard to isolate. Network reconfiguration disrupts operation.
Star 	Easy to modify and add new computers. Centralized monitoring and management. Failure of one computer does not affect the rest of the network	If the centralized point fails, the network fails.

Although these three basic topologies are simple, their real application often combine features from more than one topology and can be complex. However, in selecting the one that best suits the needs of the Ministry, a star ring would be the most appropriate combination. Figure 5.2 illustrates a star ring network.

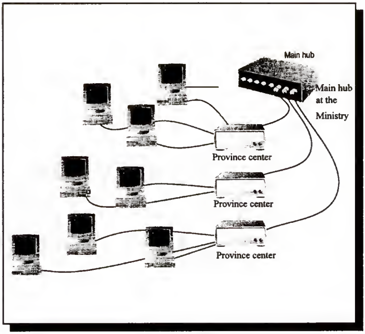


FIGURE 5.2 A STAR RING NETWORK.

Benefits to the Ministry

The Ministry of Education will not only benefit from integrating and implementing Instructional Technology in their secondary school buildings; but, additionally this research reveals a wealth of opportunities and possibilities such as, but not limited to, the following:

1. High ranking personnel at the Ministry can teleconference with any school, or all schools throughout the Kingdom, regarding instructional or educational

matters.

2. Communication between the Ministry and all school administration becomes more effective and efficient, therefore saving resources, i.e. time, paper work, delivery personnel.
3. Due to the central examination system at the 12th grade level, the Ministry can download, through the network, the exams for the different subjects to each school just prior to the examination time. This is reinforced by the one time zone throughout the country.
4. Communication between students in different schools facilitates the sharing of ideas and projects.
5. Develops a positive relationship with other students in different schools.
6. Distance learning can be achieved easily through the network, either from the Ministry or any province center.
7. Security can be managed by one central administration who sets the policy and applies it to every user on the network.

Planning the Network

Planning the physical aspects of the network for the Ministry of Education is divided into three major levels:

1. National Level,
2. Province Level, and
3. Building Level.

First, the National Level is where all 13 provinces around the Kingdom are connected to the central administration area which is located in Riyadh. It is considered to be the primary infrastructure for the Ministry. It allows each province to access the main server at the Ministry of Education. More importantly, coordination between the Ministry of Education and the Ministry of Postal, Telecommunications and Telegraph (MOPTT) is required for planning the infrastructure. Figure 5.3 illustrates the map of the Kingdom and the connection between the 13 provinces. By having a centralized administration at the Ministry in Riyadh, security can be maximized and the main server can be protected and upgraded easily. Hence, the server-based approach to networking is the most appropriate way of securing the system.

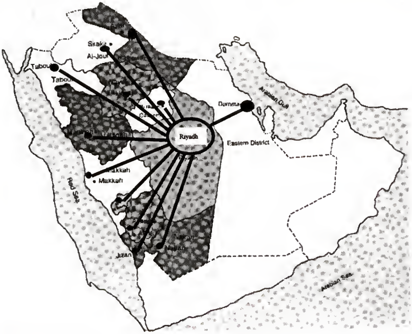


FIGURE 5.3 13 PROVINCES CONNECTED TO THE MINISTRY OF EDUCATION IN RIYADH.

The Province Level is the second level of planning the network; therefore, covering a particular geographical area in planning the network. Each secondary school is connected to the school board district at its province.

The third level in planning the network would cover the school building itself, which is the Building Level. Networks inside the building are taken from classrooms to the networking equipment room and administration area. Figure 5.4 illustrates a communication network for a school building.

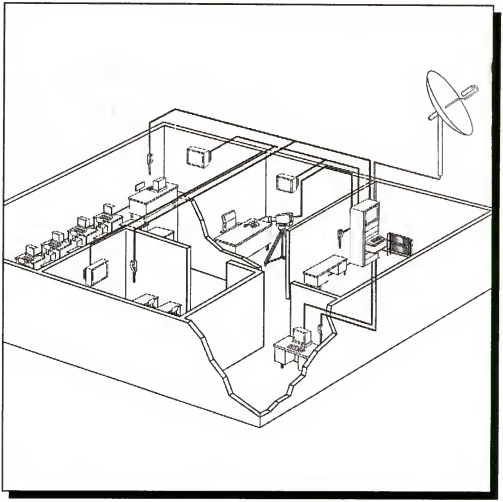


FIGURE 5.4 COMMUNICATION NETWORK FOR A SCHOOL BUILDING

Planning the physical aspects of the network includes mapping a network for each level. Each building would need a map as a guide to show where the cabling and network would be installed. The Ministry, along with the vendor, should decide what devices will be required for consideration during the planning phase.

With this technology going into the most advanced sites in the Gulf region, it is setting the trends for the rest of the world. This is partly due to the financial position of the region, but has more to do with the Kingdom's realization that this type of technology will take businesses to the next stage of efficiency and competitiveness, therefore, leading the way for educational advancement.

Modernization and expansion broadly define the two challenges facing the telecommunication sector at the start of this Sixth Development Plan. Particularly the long distance network (with its requirements for digitization and the installation of optical fiber cables, digital microwave facilities and the upgrading of satellite equipment) and the exchanges, where existing hardware and software need to be replaced. Such modernization and expansion of the telecommunication infrastructure in the Kingdom will maximize the benefit of applying the latest instructional technology in the educational sector.

There is no question that the immediate and probably long-term educational future of computer-based telecommunications is World Wide Web centered, where immediate access to its global interlinked multimedia resources is at the touch of a button. An immediate benefit to improving processing power and telecommunications speeds is that application access time will decrease significantly over the coming years. For example, Internet2, that is to be unveiled for universities in the United States, will link 100 universities

100 times the speed of the current Internet and a smaller group of schools 1,000 times as fast. Internet2 can theoretically transfer data at a speed of 622 million bits per second, compared to most home modem's speed of 28,800 bps, and is expected to be upgraded to an eventual 2.4 billion bps (Gore to Unveil Internet2 for Universities, 1998).

Implementation

It is suggested that this project be implemented in different phases, due to the vast land coverage area of the Kingdom. Furthermore, the first phase needs to be evaluated after it has been used for a 1-year cycle. This evaluation will hopefully eradicate any problems that might occur during the initial stage. It is recommended that implementation be in three phases:

Phase I:

First, the three major provinces should be connected, which includes the Headquarters at the Ministry of Education in Riyadh Province, the Eastern Province and Makkah Province in the West. Each of these provinces will choose three of its secondary school buildings to be connected to the Province center as part of Phase I. Figure 5.5 shows the three provinces that will be connected as part of Phase I.

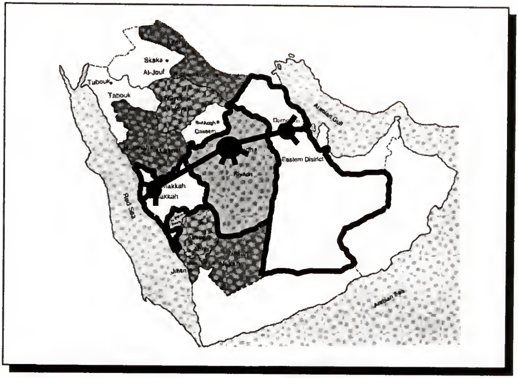


FIGURE 5.5 PHASE I, CONNECTION OF THE FIRST THREE MAIN PROVINCES TO THE CENTRAL HEADQUARTERS IN RIYADH.

With the nine schools connected to the Ministry, each school is capable of using the network to access the Internet and database through the Ministry. The Ministry can communicate with any school via the network and, more importantly, immediate teleconferencing between schools or classrooms is accessible. An evaluation and assessment of this phase is significant and needs to be done on a continuous basis, therefore minimizing any unforeseen problems that might occur in phase II.

Phase II:

Connecting the rest of the Provinces (10 Provinces) to the Headquarters. All 13 Provinces should be connected to the Ministry and each should have three of its secondary school buildings connected to the province center. By the end of Phase II, the whole country will be connected to the Ministry, except the rest of the school buildings in each province.

Phase III:

Each province starts to connect the rest of its secondary school buildings. All classrooms are to be connected and wired to the school centers, networking equipment room. By the end of this phase each school is connected to the Internet and database through the Ministry, and full advantage of this project takes place.

Layout for Existing Facilities

Existing facilities have great potential for upgrading. Because of the standard dimension size of the classrooms throughout existing school buildings, retrofitting will be more efficient and systematic. The next two sections explain and illustrate, in greater detail, different instructional technology classroom layouts and different multimedia learning center concepts for each school.

Instructional technology classroom layouts

The classroom is the fundamental educational space in the school, where most of the students and teachers spend the crux of their time. The daily educational system in secondary schools functions in a consistent manner where students stay in one classroom for different taught subjects throughout the day, from the first period to the last period, except for the laboratory and physical education. This kind of system encourages the teacher to move from class to class and therefore does not allocate the teacher's own classroom or office. All teachers are located in one office area.

In addition to the instructional technology classrooms, there will be a multimedia learning center that houses a state-of-the-art technology that features teleconferencing, satellite down links, fiber optic links, WWW, laser disc player, video player and cable links to local stations to be utilized by any instructor in lecturing, course work or for administrative purposes. Figure 5.6 illustrates a contemporary computer workstation that combines a disk and computer workstation in one.

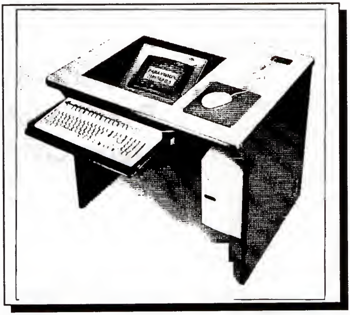


FIGURE 5.6 CONTEMPORARY COMPUTER WORKSTATION, COMBINED READING/WRITING TABLE AND A COMPUTER STATION WITH A TEMPERED GLASS AND FLAT ANTIREFLECTIVE SURFACE. (Source: Paragon Furniture, Inc. Individual Work Station ParaVision 2100).

This ParaVision 2100 Series is one of the newest workstations on the market, that combine a computer workstation and Reading/Writing table in a compact style. It is a contemporary style that features tough, durable, high pressure laminate. The recessed monitor compartment can hold a 15" monitor and measures 44.5cm W x 40.5cm L x 46cm H with easy adjustment settings and 30 degrees for comfortable visual alignment for the user. The monitor screen is viewed through an 18"x18" opening covered with low glare tempered glass for safety.

Some of the advantages that a recessed monitor workstation offers have over a stand-on monitor are

1. Monitor is protected from falling down.
2. Reduces the space needed for the workstation.
3. Eliminates the difficulty of seeing above the monitor as in a stand monitor.
4. Reduces the risk of have something spill on the monitor.
5. Hides the wiring of the monitor and the CPU.
6. Traditional lecture would not be affected.

Two important points that must be taken into consideration when implementing this type of workstation that focuses on the safety of the students and instructor, hence making it a safer use of the technology:

1. Use tempered glass on the top opening.
2. Use antireflective with low glare glass.

The following layouts of the classroom illustrate different configurations that suit the needs of the students and the instructor, while most appropriately improving the learning environment. Each layout discusses the advantages and disadvantages of each design concept in implementing instructional technology in the classroom.

Traditional computer layout

Traditional computer layout is one of the most common layouts. When computer first started to enter school curriculum, facility designers produced a separate computer lab. With the changing trend in the use of technology and developments in instructional technology a transition started to evolve. Figure 5.7 illustrates a traditional computer layout.

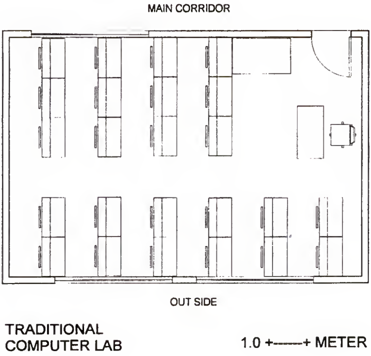


FIGURE 5.7 TRADITIONAL LAYOUT FOR COMPUTER LAB WITH THE USE OF THE PARAVISION 2100 SERIES WORK STATION.

Advantages:	Good for lecture class formats. Students can see the instructor, presentation area and their computer screens in front of them. The monitor compartment will easily accommodate 14-15" monitors. The monitor screen is viewed through an 18" x 18" opening covered with low glare, 3/16" gray tempered glass.
Disadvantages:	Single utilized aisles may create a narrower passage that could inhibit movement in and out of the classroom and make it more difficult for the instructor to help individual students. Hard for the instructor to monitor students computer screens.
Networking:	Fed from walls or floors. Each row must have its own power and communication run. Cables are routed to adjoining tables through ports in the Wire Management Panel and down to the wall or floor outlets through a Vertical Cord Manager.

Perimeter and island layout

A perimeter and island layout is anther alternative in designing an instructional technology layout of a classroom. It utilizes all walls in connecting its technology, which makes it easer to wire. However, the layout does not integrate a traditional setting and is less encouraging to have a cooperative learning in the class. The instructor can walk and monitor easily through the classroom. In this layout students concentrate on their workstation as the primary learning media. Figure 5.8 below illustrates a perimeter and island layout.

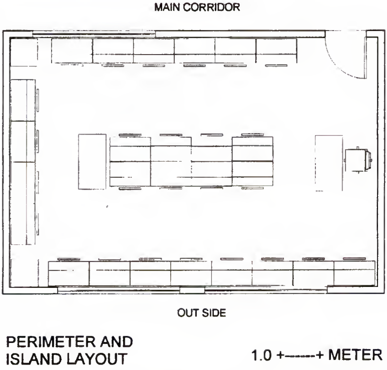


FIGURE 5.8 PERIMETER AND ISLAND LAYOUT

Advantages: Allows students to work individually in a lab setting. Good use of space. Aisles are relatively short and are double utilized to provide additional width and allow the instructor easier access to help individual students. Instructor can view multiple computer screens. Adjoining end tables provide easy access to printers and peripheral equipment.

Disadvantages: Limited lecture and presentation applications by the instructor. Some students will have to turn 180 degrees to see blackboard or presentation area.

Networking: Perimeter stations can be fed from the walls. Power/Communication Poles are a good option for island stations if floor monuments are not available. Cable are routed to adjoining tables through ports in the Wire Management Panels.

Back-to-back perpendicular layout

This layout utilizes good use of space in the classroom. With the perpendicular layout to the front of the class it give equal view for ever student. Long aisles are difficult to ease circulation in the classroom, instructor have to move back and forth to assess students at their workstation. Figure 5.9 shows a back-to-back perpendicular layout in a typical school classroom.

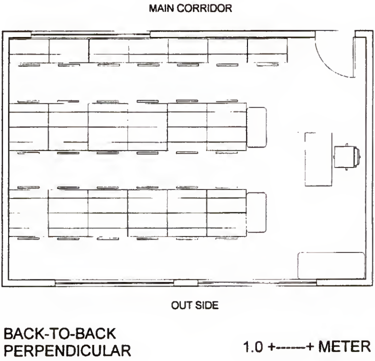


FIGURE 5.9 BACK-TO-BACK PERPENDICULAR LAYOUT

Advantages: Allows students to work individually in a lab setting mixed with an occasional lecture or presentation format. Good use of space.

Students can see the blackboard or presentation with minimal blocked views. Aisles are double utilized to provide additional width and allow the instructor to help individual students more easily. The instructor can see multiple computer screens at a glance Adjoining end tables at the end of rows provides easy access to printers and peripheral equipment.

Disadvantages: Instructor efficiency in assisting students is reduced as the rows become longer. Some students will have to turn to see the blackboard or presentation.

Networking: All stations are fed from the walls. Cables are routed to adjoining tables through ports in the Wire Management Panels. Very efficient wiring system.

Centers with a traditional classroom

Instructional technology in this type of layout is designed in a traditional layout setting. An efficient circulation for instructor to go around the classroom to observe students at their workstations. Students view the front of the class with no obstacle, therefore, making an effective lecture or presentation. Wiring are more difficult, but floor can be used to supply communication network. Ceiling can be used to supply wiring, but aesthetically unpleasant and can limit students view to the front of the class. Figure 5.10 below illustrates a centers with a traditional classroom layout.

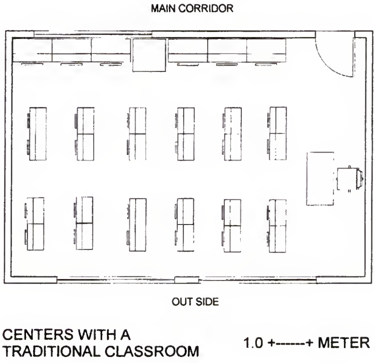


FIGURE 5.10 CENTERS WITH A TRADITIONAL CLASSROOM LAYOUT

Advantages:	Technology is integrated into a traditional classroom setting. Some students work on computer-related projects while others work at tasks in the rest of the classroom, depending on the subject in hand. The instructor has good access to give students individual assistance. A traditional lecture can be given without any obstruction to the front of the classroom.
Disadvantages:	The instructor has a limited view of multiple computer screens. Not every student has a computer as it is limited to four or five per computer. Vertical wiring from the ceiling is unpleasant and if used it will black students view to the blackboard in front of the classroom or any other presentation.
Networking:	Stations can be fed from the wall. Cables under desk tops can be kept off the floor by the Wire Management Panels. Floor should be used to wire and connect workstations.

Islands layout

Islands layout is more effective for an interactive and collaborative teaching style. Instructor have the ability to walk around and assess students at the own screen. However, the layout does not integrate a traditional setting and teaching methods. Figure 5.11 illustrates an island layout workstation.

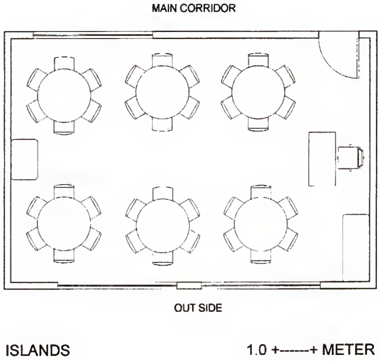


FIGURE 5.11 ISLANDS LAYOUT

Advantages: Island stations work well for collaborative learning formats (group projects or two students sharing one computer). The instructor has the best opportunity to give students individual assistance in this type of layout.

Disadvantages: This layout is not good for a presentation or lecture format because several students have a blocked view of the teacher and blackboard area. The instructor has limited view of multiple computer screens.

Networking: Island layout stations are more difficult to feed. One of the best ways is through the floor slab during construction. But, retrofitting floor channels may be expensive and messy. Power/Communication Poles that extend from ceiling to floor offer a practical solution, but are not aesthetically pleasing. Communication interface plates can be used on this pole to give computers access to telephone, data and network cables. Cables under desk tops are kept off the floor by the Wire management panels. Figure 5.12 show a class setting and an instructor workstation.

With the use of an instructor workstation it is possible to access students' monitors. Figure 5.12 show a contemporary instructional technology workstations for both the instructor and student where the teachers' computer can access students' monitors.

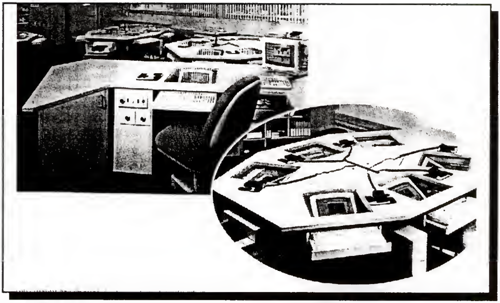


FIGURE 5.12 CONTEMPORARY INSTRUCTIONAL TECHNOLOGY CLASSROOM, WHERE THE TEACHERS' COMPUTER CAN ACCESS STUDENTS' MONITORS.

At Blackstock Junior High School in Oxnard, California, (Hoffman, 1995) a grant from the State of California allowed the school to install state-of-the-art technology. The "Smart Classroom", consists of many workstations clustered into an island layout with three to six computers each. Monitors are recessed inside and flush to the work surfaces with the CPU underneath. The instructor using the Smart Classroom can peer into students' screens from his own computer, instead of walking up and down the aisles to oversee students' work.

Multimedia learning center

When computers, televisions and VCRs can be moved easily from class to class on carts, there is less disturbance for the entire school. Presently, multimedia equipment can be very bulky to move around easily. Moreover, the school buildings in Saudi Arabia are not designed to facilitate the movement of carts. Unfortunately, schools are not designed to have ramps or elevators at all. Therefore, the most appropriate way of handling the hardware is to locate the hardware in one location; a multimedia learning center. This center must be secure, should be centrally located in the school and have the potential to be wired with the special cables often needed.

A multimedia learning center is an option that can bring technology to existing school buildings. A remodeling of a current school plan is illustrated in the following three major concepts:

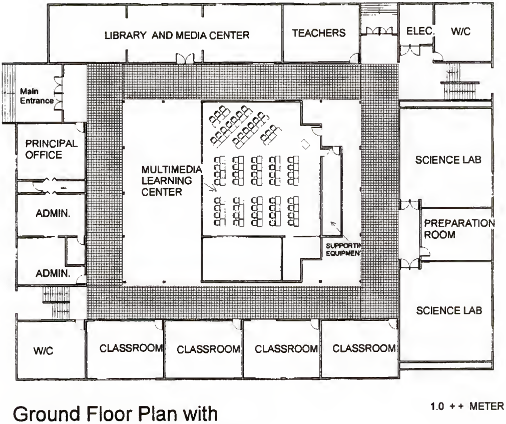
Central layout concept

This concept takes advantage of the courtyard as the major focal point of the school design. In this concept the multimedia learning center is centered in the courtyard around the major circulation of the court. Visual connection through the center is inviting and welcoming users to the center. The layout does not interfere with the existing structure, therefore, making the multimedia learning center independent and a standing sculpture in the middle of the courtyard. Figure 5.13 illustrates the concept of the central layout.

In integrating the multimedia learning center, minimum disturbance to the courtyard should be maintained, and therefore the following should be look at

* Minimizing interference with the major circulation.

* Sold walls should be avoided except for the projection area.



Ground Floor Plan with
Multimedia Learning Center
Central Layout

FIGURE 5.13 GROUND FLOOR PLAN, RETROFITTING A MULTIMEDIA LEARNING CENTER IN A CENTRAL LAYOUT AT AN EXISTING SCHOOL BUILDING.

The central layout concept have the potential to be expanded. The courtyard can be used as a large class, either for a group seminar or large lecture given by an instructor or an administrator. The courtyard can seat a large number of students to listen or/and interact with a teleconferencing session. The design concept of the multimedia learning center has the flexibility of expanding to make a larger and exciting space for students to learn.

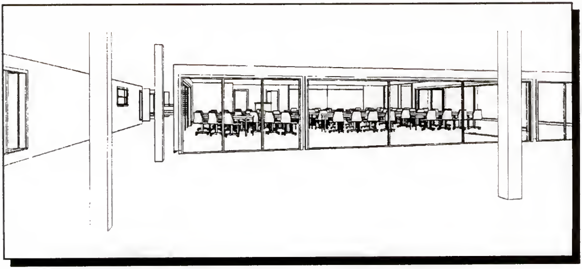


FIGURE 5.14 VIEW FROM THE MAIN ENTRANCE OF SCHOOL LEADING TO THE MULTIMEDIA LEARNING CENTER IN THE COURTYARD

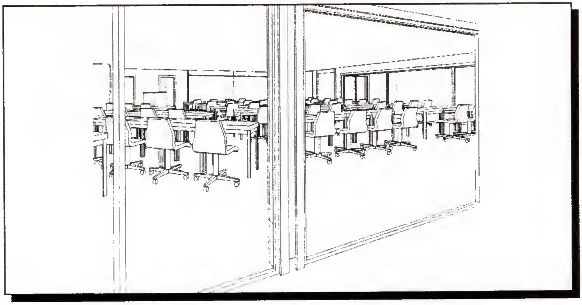


FIGURE 5.15 VIEW SHOWING WHAT STUDENT SEE WHEN WALKING AROUND THE MULTIMEDIA LEARNING CENTER

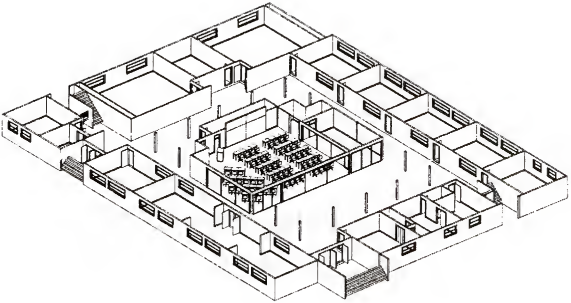


FIGURE 5.16 PERSPECTIVE VIEW SHOWING THE MULTIMEDIA LEARNING CENTER IN A CENTERED LAYOUT

Integrated layout concept

The integrated layout concept is a concept that integrates the multimedia learning center with the plan of the school. It uses two of the classrooms in retrofitting the center. The entrance of the center is part of the main circulation, it invites student while they are waking from class to class in the ground floor. However, from outside an addition can be noticed in the elevation. More importantly, this concept does not disturb the courtyard which is the main concept of the school design. Figure 5.17 illustrates an integrated layout for a typical ground floor plan showing a retrofit for a multimedia learning center.

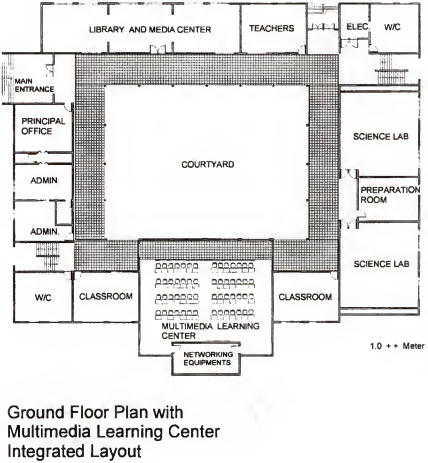


FIGURE 5.17 GROUND FLOOR PLAN, RETROFITTING A MULTIMEDIA LEARNING CENTER IN AN INTEGRATED LAYOUT AT AN EXISTING SCHOOL BUILDING

Figure 5.18 shows a close detail of the multimedia learning center equipped with the latest instructional technology for students and instructor. The center has full capability for conducting teleconferencing and other communications with other schools around the kingdom and around the world.

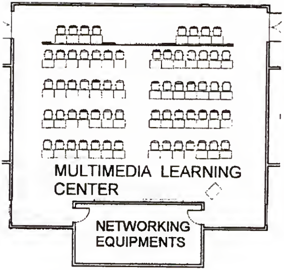


FIGURE 5.18 LAYOUT OF A MULTIMEDIA LEARNING CENTER EQUIPPED WITH THE LATEST INSTRUCTIONAL TECHNOLOGY.

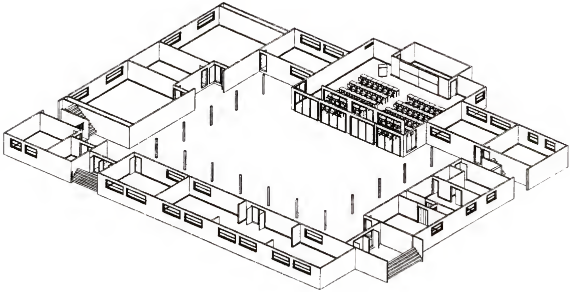
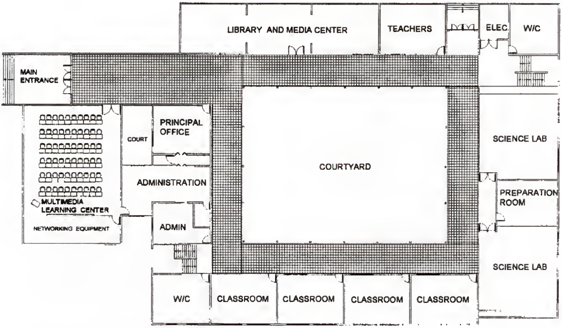


FIGURE 5.19 PERSPECTIVE VIEW SHOWING THE MULTIMEDIA LEARNING CENTER IN AN INTEGRATED LAYOUT

Extension layout concept

The extension layout connects with the outside structure of the school building. Physically it is attached to the administrative area and it is part of the main entrance, subsequently inviting students as they step into school. Figure 5.20 shows how the extension layout relates to the existing school building.



Ground Floor Plan with
Multimedia Learning Center
Extension Layout

1.0 + + Meter

FIGURE 5.20 GROUND FLOOR PLAN, RETROFITTING A MULTIMEDIA LEARNING CENTER IN AN EXTENSION LAYOUT AT AN EXISTING SCHOOL BUILDING

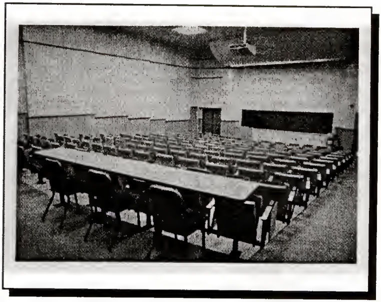


FIGURE 5.21 MULTIMEDIA LEARNING CENTER PROPOSED FOR THE EXTENSION LAYOUT PLAN.

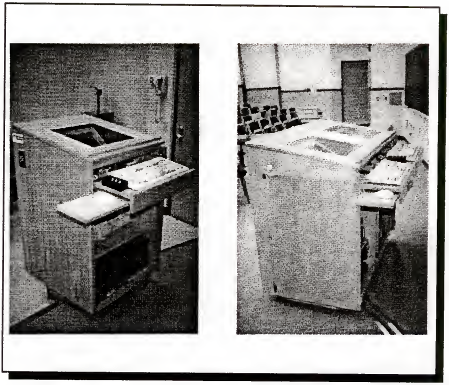


FIGURE 5.22 EXAMPLE OF SINGLE OR DOUBLE TECHNOLOGY PODIUMS FOR THE INSTRUCTOR USE

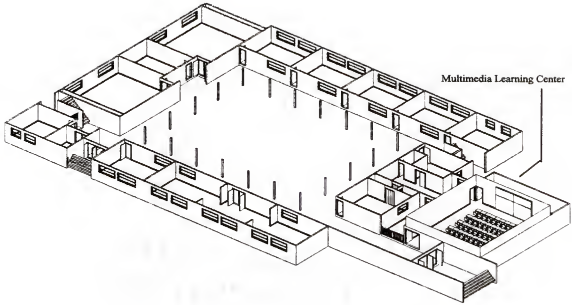


FIGURE 5.23 PERSPECTIVE VIEW SHOWING THE MULTIMEDIA LEARNING CENTER IN AN EXTENSION LAYOUT CONCEPT

Conceptual Economic Investment Model

Instructional technology cost should be analyzed to ensure that the implementation of the project is optimal and that it can be financially sustained over its projected life. Provided an appropriate cost analysis framework is used, the flexibility of the instructional technology plan can be assessed, trade-offs can be considered explicitly and other options that preserve the plan's goals can be evaluated. Using an analytical approach will increase the likehood that technology will find its way into the Ministry and all the way to the school and that its implementation will be successful. Due to the Ministry in charge of the entire educational system, it is assumed only one technology model is implemented nationwide and that the technology applied in uniform waves over a finite period of time, which had been mentioned perviously.

As instructional technology gain increasing attention there will be increasing value in positioning all related activities as a single budget. In this way, changes from year to year can be evaluated, and the value of older hardware determined. The budget should include both the actual technology products and services, as well as the facility modifications and retrofitting, staff development, personnel, etc. that is dedicated to support the instructional technology plan.

In developing the technology plan that will put instructional technology into the Kingdom's schools, there are some important steps of analysis required to be considered in the investment

1. The technology plan should be formulated around the Kingdom's educational goals.
2. This will clearly define the technical and functional requirement needed to facilitate the Kingdom's educational goals.
3. Potential instructional technology solutions will be shaped by these specifications.
4. Once the plan is formulated, its technical and operational feasibility should be assessed.
5. The cost of at least one other feasible technical alternative should be

evaluated.

6. The cost of the entire technology plan should be analyzed by developing a model of the life-cycle costs of the plan.

Figure 5.24 illustrates a conceptual investment model that shows how expenditure would be spend for the next fifteen year. The first three years of implementation covers the major spending and initiation of the project, implementing phase-I in the first year, which covers the three main provinces. The seconde year investment covers Phase-II of the project which implements the rest of the 13 provinces. Phase-III of the implementation is covered in the third year investment model that covering the rest of the secondary schools throughout the Kingdom.

The first upgrade is recommended after five years from the start of the project. Upgrades are to cover hardware, software programs and any other related items that will improve the instructional technology. In the investment model, subsequent upgrades are to be done every three years.

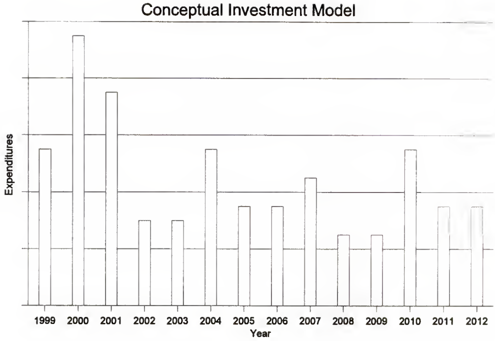


FIGURE 5.24 CONCEPTUAL INVESTMENT MODEL ILLUSTRATING EXPENDITURE ON INSTRUCTIONAL TECHNOLOGY FOR THE NEXT FIFTEEN YEARS

Staff Development and Training

Instructional technology alone offers no solution, it can not motivate unless it is in the right hands to make learning fun and effective. It offers unlimited learning opportunities when paired with the right teacher. When planning for instructional technology in an educational facility, we need to recognize that there is more to the equation than hardware and software; staff development is a vital third component and requires equal attention. Kook (1997) emphasizes that the role of an instructor is much more important in today's information age than it was when the instructor was the source of all knowledge. Instructors must be part of any systematic plan for integrating instructional technologies and communication into the classroom. The preparation of Saudi teachers is an obvious and crucial issue to be addressed if the successful implementation of Instructional Technology and communication technologies in the Saudi Arabian schools is to happen. The technology planning committee at the Ministry is responsible to develop programs and other training session to further develop staff understanding of the technology, its use and potentials in their classrooms.

Instructional technology is a highly versatile tool, and instructors have been slow to employ advanced computer applications in their classrooms. Instructors today need to be competent in the use of a variety of telecommunications ranging from multimedia applications to Internet usage. Some of the basic skills needed for instructors at the secondary school level are listed as follows (Kook, 1997):

1. Navigate desktop environments in Windows.
2. Use WWW services
3. Send and receive E-mail via national and international communication networks
4. Operate laser optical devices: DVD (Digital Video Disc), CD-ROM and videodisc.
5. Create a home-page on the Internet.
6. Participate in a two-way interactive teleconferencing setting.
7. Search CD-ROM and Internet for specific information.

8. Use an optical scanner.
9. Use an LCD projector for instructional purposes.
10. Use graphics programs to create graphics for educational illustrations and animation.
11. Chat with others in different chatrooms

Staff development activities are designed to further develop teachers skills in using a wide variety of information resources and in working with other professionals on restructured approaches to teaching and learning. The technology planning committee has the responsibility to arrange at each province to have training programs presented during the school year that allow teachers to try out new ideas and programs immediately. However, summer training can be more intensive and should be utilized. Training on the use of the Internet is to be made a top priority; therefore, making the users as self-sufficient as possible.

Upgrading

Technology can be divided into two main physical components. The network communication which is the media that carries the information from place to place, and the hardware of the computer equipment and instructional media that is used at the sending and receiving ends. With a Fiber Optic infrastructure laid out throughout the country by the Ministry of Posts, Telegraphs and Telephones (MOPTT), the communication network will be at its peak efficiency. Installing the fastest network available on the market is most advantageous in the long run. Once they are in place, either underground or in a building's structure, they are very difficult to change or upgrade. Thus, for maximum flexibility inside the existing school building, cable trays should be suspended below the ceiling grid so that cable can be added easily without major maintenance.

MOPTT is initially investing a large amount of money to cope with, at least, the next 20 years. On the other hand, instructional media and computer equipment is changing so rapidly that when a purchase is made of the newest technology the next month an upgrade is available. The Ministry of Education should take this situation seriously and adjust accordingly by purchasing the newest technology on the market and plan to upgrade within 3-5 years. Any upgrade should be coordinated with the curriculum development department at the Ministry and be consistent with the educational goals.

Technology Planning Committee

A Technology Planning Committee at the Ministry of Education is formed in order to make sound decisions about the instructional technology infrastructure, resource allocations, staff development and successful systemic changes. While each of the 13 provinces is assigned a technology specialist who supports and directs the progress of the province, the technology planning committee is responsible for monitoring and evaluating the progress of the instructional technology at each of the 13 provinces. For the committee members to be able to accomplish their tasks effectively and efficiently, they need to be provided with crucial information. Some of the most important information includes the most current research on instructional technology, communication developments and school designs. In order for the committee to accomplish its task it will:

1. Meet at least three times in a school year to assess the implementation of the Technology Plan; at the beginning of the year, in mid-year and at the end of the year .
2. Reassess the goals and activities of the Technology Plan in order to ensure that it reflects the current situation as well as the Five-Year Development Plan of the country.
3. Assess the degree to which Instructional Technology has enhanced communication between the schools within a province and outside the province.
4. Assess the degree to which Instructional Technology has been integrated into normal classroom teaching.
5. Assess the progress of staff development with regard to faculty and student computer literacy.

Future Impact

Technology is making a profound impact on education across the globe, and it is a positive impact. With the implementation of this project the future holds great opportunities for advanced achievements in the educational system and school buildings in Saudi Arabia. Some of the major impacts that this project would have in the future are

1. Educational technology will demonstrate a significantly positive effect on student's achievement in all major subject areas.
2. Educational technology will have positive effects on student attitudes toward learning and on student's self awareness and individual development. Student's will feel more successful in school, more motivated to learn and have increased self-confidence and self-esteem through the use of computer-based instruction.
3. Learning is expected to be more student-centered, encouraging cooperative learning and stimulating increased teacher/student interaction.
4. This project will hopefully bring about an evolutionary change rather than a revolutionary change in the learning environment, through the use of instructional technology.
5. Knowledge is power and the class of 2020 will be equipped with the power of information that they have to compete globally.
6. A stronger economy is expected with graduates who are embraced with the technology in this information age.
7. Boundaries between countries will dissipate; therefore, creating a Global Community.
8. Exposure to this information age will bring about a shared interest between different societies.
9. Students are not limited to friends in just their classroom; but a student might have ten friends from ten different countries, sharing cultural values and

interests, even arranging to meet in the Kingdom during the summer.

10. Parents can access their children's information records in school using a computer at home.
11. This project will impact the implementation of instructional technology in other sectors of education including elementary, intermediate, universities and all girls education levels.

Conclusion

Instructional technology in the educational sector is here to stay. If one thing is certain, hardware will get smaller and be more portable. Planning for what is here today can only promote future use. Architects and facilities designers must be aware of the changes that the convergence of computer technology and instructional technology will bring. On this technological super highway there will be innovations, as well as gadgets and retarded technologies. But, most important, is having the best and latest infrastructure in place for the coming communications network. With the MOPTT installing its Fiber Optics network as its infrastructure and backbone for the country, the Ministry of Education will take advantage of this latest network in connecting its schools and classrooms.

The implementation of this thesis by the Ministry of Education, throughout the Kingdom will encourage the greatest development in its secondary schools. Students entering secondary school today will graduate and live in the 21st century. Their needs will be dictated by a rapidly changing society. The responsibility of the Ministry is to prepare students to live in this rapidly changing world. Decisions made today will have major effects on the quality and efficiency of the education delivered to students of today and tomorrow. Most importantly, Saudi students need the technological tools and resources to help them learn and achieve in the future.

Designing educational buildings in Saudi Arabia, and elsewhere around the world, in this information age is an increasing challenge to architects. In this generation, tremendous developments in the field of instructional technology have had a powerful impact on the demand for upgrading and improving the design of educational spaces. This research recommends that the Ministry of Education upgrades its technology plan in 3-5 years. This trend will continue to change as development in instructional technology continues to be in a state of flux.

CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

Introduction

What has been addressed in this thesis is only the first step on the journey to take the educational institutes in the Kingdom to an advanced instructional technology and telecommunications era. This research has resulted in new insights regarding the design of secondary school buildings in the Kingdom of Saudi Arabia. The greatest benefit of the implementation of this research in the Kingdom's school system is that of optimizing the design of the learning environment with the latest technology for teaching and improving instructional values to students and teachers. Students can have information at their fingertips, from materials they access for learning and special projects from peers in the Kingdom and around the world.

As electronic technology continues to evolve in this information age, the Saudi government remains enthusiastic in upgrading its educational system for the different five-year development plans. This is especially apparent in light of the recent Sixth Development Plan, that gives the education sector priority for upgrading. Undoubtedly, the Kingdom is willing to advance its school system into a progressive stage of telecommunications and instructional technology.

Conclusion

The conclusions drawn are that the concepts of designing schools and learning environments currently adapted in many Saudi educational institutions are outdated, and that a new paradigm supportive of advanced technologies is slowly beginning to emerge. Literature cites countless examples of innovative and effective use of the new technologies to improve and enhance the learning environment. However, there still remains many classrooms where the technology has had little or no effects, and perhaps more importantly, many students who are leaving schools with no skills in utilizing the new technologies.

To maintain world-class status as a nation, the researcher stresses that the Kingdom needs to continue to develop its instructional technology in the educational system, facilitating the extensive use of technology throughout all levels of the educational sectors. The ability to use the Internet through the instructional technology in the classrooms, and more specifically teleconferencing and e-mail, are means to make the walls of the classroom "vanish." Students are going to make virtual field trips, communicate with classrooms around the block and around the globe. With the power of the Internet, the classroom is no longer in the physical building at the end of the street, but it is a global classroom linked to other classrooms around the world.

Research Contribution

The implementation of the research on state-of-the-art instructional technology strategies for Saudi secondary schools built by the Ministry of Education is expected to occur at three levels of management. At the first level, the "Ministry level", which covers the

Ministry of Education Headquarters in Riyadh and its personnel, the following changes can take place:

1. In charge personnel at the Ministry, such as the Minister of Education and others, will be able to teleconference with any school or all schools throughout the Kingdom, regarding instructional, educational or administrative issues.
2. Communications between the Ministry and the entire school administration will become more effective and efficient, therefore saving resources, i.e. time, paper work and delivery personnel.
3. The Ministry will be able to download, through the network, the exams for the different subjects to each school just prior to the examination time. This is due to the centralization of exams at the 12th grade level and is supported by the one time zone throughout the country.
4. Distance learning will be easily achievable through the network, either from the Ministry or any province center.
5. Security will be manageable by one central administration, represented by the Ministry of Education, which sets the policy and applies it to every user on the network.
6. A Technology Planning Committee at the Ministry will administer decisions about Instructional Technology developments.

Second, at the province level, the following changes can take place:

1. Communications between provinces will be enhanced, thus increasing the sharing of projects and resources.
2. Competition between different provinces will improve to excel in their educational mission, therefore raising the students learning standard.
3. Technology Specialist will be assigned to support, direct and coordinate the progress of the province with respect to instructional technology.

Third, at the school level, the following changes can take place:

1. New design concepts will evolve for schools with the implementation of instructional technology in this information age.
2. The multimedia learning center will become a focal point for learning, where student are no longer in a local school learning environment but are in a global learning center.
3. A Multimedia Specialist in each school will be appointed, hence supporting the school and staff in overcoming any difficulties in using the technology during their daily activities.
4. Students will acquire the necessary skills and understanding needed to succeed in the next millennium.
5. Communication between students using teleconferencing, E-mail and other

current technologies will facilitate the sharing of ideas and projects, therefore demonstrating a positive effect on student's achievement.

6. Positive relationships will be developed among students in different schools.
7. The school itself will be represented by the students and instructors can compete and share projects and information with other schools in their Province, Nationally or Internationally.
8. Accessing the Internet in schools will be safer for students, due to Ministry control over the WWW.

Although these three categories are in different hierarchal levels, they are all part of a comprehensive strategy that the Ministry of Education needs to implement in making this project a success. The researcher further emphasises the development of the technological skills of staff in each school therefore giving such development a priority when further upgrades are required. The technology planning committee is going to make significant contributions in subsequent upgrades in technology for the future of educational.

Recommendations for Future Research

The researcher recommends that the Ministry of Education, with its primary responsibility being to providing boys general education, further investigate the application of instructional technology at both the Intermediate and Elementary levels. Other government agencies such as the General Presidency of Girls' Education, that is responsible for girls general education, should consult with the Ministry of Education regarding studying and looking at planning and implementing instructional technology at their schools.

A promising further application for this research is in applying it at the university level and other higher institutes of learning. With rapid developments in the instructional technology, particularly in the last decade, the Ministry must look ahead to the next generation of technology for use in education. While a significant amount of work has been done in this thesis that contributes to the design of secondary school buildings and planning for a comprehensive implementation of instructional technology, more research and further investigation are needed in both integrating the technology throughout the curriculum and development of distance learning through teleconferencing. Opportunities for elderly education should be maximized, with the use of the communication network and technological advancement in education there is great potential to further develop and enhance education for every one in the society regardless of age and gender.

Other possible areas of investigation include linking via satellite and integrating different higher institutes and organizations around the Kingdom and the world with secondary school instructional technology to optimize the educational benefits. The possibility of linking with major conferences at universities and other organizations that benefit students educational process should be look at. Both the educational structure in Saudi Arabia and the successful implementation of instructional technology at its secondary school should launch further cooperation and integration with other educational structures in the gulf countries. Architects and designers need to stay current with advancements in instructional technology that influence the design of educational facilities around the world.

APPENDIX A
VENDORS FOR INSTRUCTIONAL TECHNOLOGY FURNITURE FOR SCHOOLS

Appendix "A" gives an alphabatical list of the major vendors for instructional technology furniture for schools. Full information about each vendor is given, full address, contact telephone number, fax number, E-mail and their homepage on the Internet.

ANTHRO CORPORATION
10450 S.W. Manhasset Drive
Tualatin, OR 97062 USA
Tel. 503-691-2556
Fax. 503-961-2409
1-800-325-3841
E-mail: sales@anthro.com
Internet homepage: http://www.anthro.com/

BRETFORD MANUFACTURING, INC.
11000 Seynour Avenue
Franklin Park, Illionis 60131 USA
Tel. 847-678-2545
Fax 847-678-0852
1-800-521-9614
E-mail:
Internet homepage: http://www.bretford.com

CANON VISUAL COMMUNICATION SYSTEM DIVISION
One Canon Plaza
Lake Success, NY 11042 USA
Tel. 516-328-5960
Internet homepage: http://www.palo.com/webview/vcc1.htm

NOVA SOLUTIONS, INC.
421 West Industrial Avenue
P.O. Box 725
Effingham, Illinois 62401
Tel. 217-342-7070
Fax 217-342-7006
1-800-730-6682
E-mail: novadesk@effingham.net
Internet homepage: http://www.novadesk.com

MicroCenter, CONTINENTAL ENGINEERING GROUP, INC.
5302 No. Irwindale Avenue
Irwindale, CA 91706
Tel. 818-338-0870
Fax 818-338-5807
E-mail: micrcntr@cris.com
Internet homepage: http://www.microcentre.com

PARAGON FURNITURE, INC.
6420 Wuliger Way
Ft. Worth, Texes 76180 USA
Tel. 817-581-4045
Fax. 817-581-4048
1-800-451-8546
E-mail: paragon6@ix.netcom.com
Internet homepage: http://www.paragoninc.com

PAXTON PATTERSON
5719 W. 65th Street
Chicago, IL 60638 USA
Fax: 708-594-1087
1-800-323-8484
E-mail: paxtonpatterson@juno.com
Internet homepage: http://www.paxtonpatterson.com

PICTUREPHONE DIRECT
200 Commerce Drive
Rochester, NY 14623-3589 USA
Tel. 716-334-9040
Fax. 716-359-4999
1-800-521-5454
E-mail: info@picturephone.com
Internet homepage: http://picturephone.com/

RAULAND-BORG CORPORATION
3450 West Oakton Street
Skokie, IL 60076-2951 USA
Tel. 847-679-0900
Fax. 847-679-0625
Internet homepage: http://www.rauland.com

SIMTH SYSTEM
P.O. Box 860415
Plano, Texas 75086 USA
214-424-6591
Fax: 214-578-2631
1-800-328-1061
E-mail: furniture@smithsystem.com
Internet homepage: http://www.smithsystem.com

SMART TECHNOLOGIES INC.
Suit 600
1177 11th Ave. SW
Calgary, AB. Canada
Fax: 403-245-0366
1-888-427-6278
E-mail: sales@smarttech.com
Internet homepage: http://www.smarttech.com/smartboard.htm

SPECTRUM INDUSTRIES INC.
1600 Johnson Street
P.O. Box 400
Chippewa Falls, WI 54729-0400
Tel. 800-235-1262
Fax 800-3350473
E-mail: spectrum@spectrumfurniture.com
Internet homepage: http://spectrumfurniture.com

VIRCO MFG. CORPORATION
2027 Harpers Way
Torrance, CA 90501 USA
Tel. 501-450-1106
Fax. 310-328-0292
1-800-813-4150
E-mail: virco@ix.netcom.com
Internet homepage: http://virco-mfg.com

APPENDIX B
SOFTWARE PROGRAMS

Educational software was limited a decade ago, and what little there was consisted mostly of "drill and practice" electronic sheetwork, therefore choosing any software that remotely touched on the subject was often selected. However, today educational software is contributing significantly in the learning process, and software selection is taken as seriously as the selection of a text book. The following steps outline some of the important criteria in selecting a competent software for educational purposes:

1. Analyze the Needs

   The instructor and the Curriculum Committee should first determine whether or not Instructional Technology is the appropriate medium to use to satisfy the goals and objectives of the subject taught. There is always the possibility that a careful analysis will determine a fully integrated or some use of Instructional Technology in the classroom.

2. Specify the Requirements

   If a careful needs analysis determines that Instructional Technology is one of the methods that will be used to meet instructional objectives, the instructor should then specify the requirements for the computer software. Factors to consider in specifying requirements for software include:

   * Direct correlation with the Instructional Technology and curriculum requirements
   * Compatibility with available hardware
   * Level of interaction
   * Adequacy of documentation
   * Access to technological support
   * User friendly
   * Cost

3. Identifying Favourable Software and reviews

   There are many ways to identify favourable software, in charge person should use as many of them as possible. Catalogs still remain an important source for descriptions of software. Also different software is described and reviewed in magazines and some journals. Internet search, descriptions and reviews of currently published educational software programs, can give clear identification of software potentials and limitations.

4. Preview Software

The most effective way to judge whether software is appropriate or not is to observe students as they interact with the program. Are the educational objective achieved when the student uses the program? Some software vendors will allow free preview.

5. Recommendations for purchase

When purchasing a software, in charge personal should be able to:

* select the most desirable
* Establish a quantitative
* Evaluate the relative importance
* Create a written record

6. Evaluation and Feedback

Each software should be evaluated by the user. Instructor should determine the conformance or discrepancy between all of the enabling objectives of the course and the students performance using the selected software. Comments should recorded, this can be a significant help to the Ministry systematic process of software selection, purchase and use. Finally feedback from teachers and students can serve to improve future software selection process.

Here are some common softwares packages that are used by some schools for their instructional purposes:

SuccessMaker:

Is an interactive state-of-the-art educational software package from Computer Curriculum Corp. (CCC). It is a key to success in computer-base instruction. This comprehensive courseware provides students with individualized instruction, and provides teachers with tools to manage instruction and monitor student progress. Though its use of multimedia with sound, animation and video, SuccessMaker brings reading, mathematics and science to life for students, enabling them to learn basic skills as well as critical thinking and open-ended exploration. The courseware also allows students to work at their own pace, using the learning style that suits them best. Similarly teachers can match their teaching styles. They may utilize the presentation stations for small-group or whole-class instruction; they may let their students work independently at the computers, or they can act as a "learning coach" to help guide students over rough spots or point them toward extended learning activities.

School House Software:
Reviews some of the best software programs that are usful for educational purposes. In addition, it rates each program title from one to five, with 5 being the best. Tital descirbtion of each software is given, as well as advantages and limitations are explained. Software company address is given in full, cost of software and system requriements to operate the program:

Internet homepage:
http://www.worldvillage.com/wv/school/html/scholrev.htm

APPENDIX C
INTERNET EDUCATIONAL SITES

Appendix "C" lists selected educational sites located on the Internet alphabetically. The selection of the sites have been based on the curriculum needs and educational goals of the secondary schools of Saudi Arabia. The different sites will reinforce the teaching and enhance the subject taught. Some sites can be combined for different subject, therefore, instructors needs to analysis the capability and limitation of each site that fits his course work.

Site Name: *An Inquirer's Guide To The Universe*
Site Description: You'll find a helpful list of current space science fact resources. You'll also find a list of space science fiction resources.
Web Address: http://www.fi.edu/planets/planets.html

Site Name: *21st Century Problem Solving*
Site Description: Problem solving strategies for Algebra I, Chemistry and Physics. In particular, there are 13 great Algebra I story problems that illustrate their problem solving approach, with solution sets.
Web Address: http://www2.hawaii.edu/suremath/home.html

Site Name: *Oxford University Computing Laboratory*
Site Description: Oxford university brings us a brief, entertaining and well linked history of algebra and Computing, from the ancients to analytical engines to recent developments.
Web Address: http://www.comlab.ox.ac.uk

Site Name: *A Fractals Lesson*
Site Description: This fractals lesson for elementary and middle school students has students make a fractal, look at what's so cool about fractals, and explore fractals on the web.
Web Address: http://cml.rice.edu/~lanius/frac

Site Name: *A Primer on Molecular Genetics*
Site Description: An introduction to molecular biology, genetics, and the Human Genome Project.
Web Address: http://www.gdb.org/Dan/DOE/intro.html

Site Name: *A Question of Genes: Inherited Risk*
Site Description: The PBS special "A Question of Genes" explores questions and ethical issues raised by genetic research and genetic testing. This website features career interviews with genetic professionals, an educational guide and chances to send questio
Web Address: http://www.pbs.org/gene

Site Name: *About Rainbows*
Site Description: Somewhere over the rainbow! This site tells you everything you wanted to know about rainbows and more. Photographs, charts and lots of scientific information.
Web Address: http://www.unidata.ucar.edu/staff/blynds/rnbw.html

Site Name: *Access Excellence*
Site Description: Access Excellence is a national educational program sponsored by the biotechnology industry pioneer, Genentech, Inc., that puts high school biology teachers in touch with their colleagues, scientists and critical sources of new scientific
Web Address: http://www.gene.com:80/ae/

Site Name: *Acid Rain Monitoring Program*
Site Description: Run by the Canadian government, you'll find the latest statistics about Acid Rain here.
Web Address: http://www.gov.nb.ca/environm/air/

Site Name: *AIDS Archive*
Site Description: The National Institutes of Health database provides AIDS statistics, daily summaries of AIDS-related articles in major U.S. newspapers, full-text articles from the AIDS
Treatment News magazine, plus online AIDS pamphlets.
Web Address: gopher://gopher.niaid.nih.gov:70/11/aids

Site Name: *Airplane Noise Simulator*
Site Description: The Simulator shows an airplane's noise as circles moving over a map. Different colored circles show different levels of loudness. A plane's noiseness, climb, direction, and speed can be adjusted with scrollbars.
Web Address: http://www.scican.net/~sos/jetNoise.html

Site Name: *Alien Autopsy - A Case for Skeptical Inquiry*
Site Description: Activity for teachers and their students to explore, discuss, and deal with pseudoscience concepts on the Internet. Uses alien autopsy video and Hale-Bopp comet resources.
Web Address: http://www.tufts.edu/~jlarsen/alien/alinq.html

Site Name: *Amazing Space: Education On-Line from the Hubble Space Telescope*
Site Description: Amazing Space is a set of web-based lessons designed by teachers in collaboration with scientists at the Space Telescope Science Institute. The lessons in Amazing
Space are interactive and use Hubble Space Telescope images to teach scienc
Web Address: http://www.stsci.edu/pubinfo/amazing-space.html

Site Name: *An Amazon Adventure*
Site Description: An Amazon Adventure comes as a result of several teachers going on an Earthwatch Expedition called "Amazon Katydids." View photographs of the Amazon River Basin, wildlife, indigenous people, and the city of Iquitos.
Web Address: http://168.216.210.13/amazon/index.htm

Site Name: *Animal Information Database*
Site Description: Information and wonderful photos of many animals to research and enjoy! Also career information and more educational resources to explore.
Web Address: http://www.bev.net/education/SeaWorld/

Site Name: *Antarctica Meteorology Research Center Image Archive*
Site Description: Contains colorful, up-to-date satellite images of the Antarctic Continent. Very cool!
Web Address: gopher://gopher.ssec.wisc.edu:70/11/amrc.d

Site Name: *Apollo 11 Mission to the Moon*
Site Description: The sights and sounds of what it was like 25 years ago when men first walked on the moon. Download movies, pictures, and sounds or perhaps just browse through the history.
Web Address: http://www.gsfc.nasa.gov/hqpao/apollo_11.html

Site Name: *Appetizers and Lessons for Math and Reason*
Site Description: This site is based on three books by Alan Selby. It consists of 16 "appetizers" which could be used as starters for math lessons. The mathematics involved ranges in level of complexity from kindergarten to post secondary.
Web Address: http://www.cam.org/~aselby/lesson.html/

Site Name: *Archimedes' Constant*
Site Description: More scholarly calculus and trigonometric approach to looking at Pi. Also includes superb links to "Unsolved Mathematics Problems."
Web Address: http://www.mathsoft.com/asolve/constant/pi/pi.html

Site Name: *Ask An Engineer*
Site Description: Do you have any questions about electronics engineering, satellite technology, or bio-related technology? Morris Tischler (inventor and author of more than 95 books) and his staff will be glad to field your questions.
Web Address: http://www.omgsic.com/ask.htm

Site Name: *Ask Dr. Math*
Site Description: Ask a math expert about any math topic imaginable!
Web Address: http://forum.swarthmore.edu/dr.math/dr-math.html

Site Name: *Ask-a-Doctor*
Site Description: What causes cancer? Ask a doctor any and all of your questions.
Web Address: http://www.rain.org/~medmall/ask/index.html

Site Name: *Association for Science Education*
Site Description: "Teachers helping teachers to teach science." This site belongs to the UK's largest educational association for science teachers, technicians and advisors and is dedicated to the teaching of science. Don't miss their science links!
Web Address: http://www.ase.org.uk/

Site Name: *Astronomical Image Library*
Site Description: Astronomy enthusiasts will delight in this searchable central database of 15,000+ astronomical images, all available for your Net viewing pleasure.
Web Address: http://www.syz.com/images/

Site Name: *Astronomy Educational Resources on the Internet*
Site Description: Links to related curriculum, as compiled by NASA.
Web Address: http://www-hpcc.astro.washington.edu/scied/astro/a

Site Name: *Beakman's Electric Motor*
Site Description: Here find simple instructions for building a working electric motor using very inexpensive materials (a piece of wire, two paper clips, a rubber band, a magnet, and a D cell battery).
Web Address: http://fly.hiwaay.net/~palmer/motor.html

Site Name: *Bee-EYE*
Site Description: See the world through the eyes of a honey bee. This simulation allows three options for viewing: pre-processed images, hover in front of a pattern, and submitting an image with your own parameters. Very cool!
Web Address: http://cvs.anu.edu.au/andy/beye/beyehome.html

Site Name: *Beyond Bio 101*
Site Description: The Howard Hughes Medical Institute has published a new book "Beyond Bio 101: The Transformation of Undergraduate Biology Education." You will find "Beyond Bio 101" in its entirety on the Web at this site! A must read for all secondary Level.
Web Address: http://www.hhmi.org/BeyondBio101

Site Name: *Biffa-HTI Environmental Trust Fund*
Site Description: This site has been established to make a variety of information on Waste Management available to a wide audience so that the issues involved are widely understood. Users will include schools, colleges and universities.
Web Address: http://www.biffa-hti.org.uk

Site Name: *Bill Nye the Science Guy*
Site Description: A Web site for one of the most popular science guys on television, Bill Nye.
Activities, links to information about the latest episodes, and more.
Web Address: http://nyelabs.kcts.org

Site Name: *BioChemNet*
Site Description: The BioChemNet is a directory of the best biology and chemistry educational resources on the net. Resources are organized under the following topics: General Biology, Cell Biology, Genetics, Microbiology, Immunology, Biotechnology, General
Web Address: http://schmidel.com/bionet.htm

Site Name: *Biology.Com*
Site Description: The Biology Place offers Web-based Student Activities, Research Updates, and Links to useful sites for introductory biology instructors as the high school and college levels.Genetics coverage is active.
Web Address: http://WWW.BIOLOGY.COM

Site Name: *Blazing a Genetic Trail: Research on mutant genes and hereditary diseases.*
Site Description: HHMI's colorful Web book describes the excitement in biomedical research as scientists discover the causes of baffling diseases: abnormal genes. Included: family studies.
Web Address: http://www.hhmi.org/GeneticTrail/

Site Name: *Blustery Beginnings // Wind*
Site Description: What do your students already know about wind? That's a tough question. Each one brings an entirely different history to your classroom.
Web Address: http://sln.fi.edu/tfi/units/energy/blustery.html

Site Name: *Bradford Robotic Telescope*
Site Description: The world's first remote and robotic telescope on the World-Wide Web. Visitors submit job orders using a form available at the Web site, and each night the telescope
performs the job and completed jobs are posted on the web page the following day.
Web Address: http://www.telescope.org/rti/index.html

Site Name: *Build-It-Yourself: Student's Gallery!*
Site Description: An innovative, ongoing series of multimedia files inspiring kids between 8 and 16 years to build whimsical contraptions primarily out of recycled materials.
Web Address: http://northshore.shore.net/~biy/

Site Name: *Butterfly World*
Site Description: Butterfly World is one of Florida's most beautiful and educational attractions
featuring thousands of live butterflies in their natural habitat along with a variety of other exotic flora and fauna.
Web Address: http://www.introweb.com/butterfly

Site Name: *Calculus and Mathematics Home Page*
Site Description: Produced by the University of Illinois, it contains lessons for those using and
teaching with Mathematics software. It also includes links to other sites.
Web Address: http://www-cm.math.uiuc.edu/

Site Name: *Capital Area Math/Science Alliance Home Page*
Site Description: The Capital Area Math/Science Alliance is an initiative in the Harrisburg, PA region. The home page has numerous links to mathematics and science education resources for teachers, students, and interested individuals.
Web Address: http://www.caiu.k12.pa.us/msahome/msamain.htm

Site Name: *Carnegie Science Academy*
Site Description: The Carnegie Science Academy Web Site was designed for teens in grades 9-12 who are interested in science and technology. The Web site allows teens around the world to become part of the Academy and participate in events online.
Web Address: http://csa.clpgh.org

Site Name: CEA Science Education Pages
Site Description: Contains lesson plans and activities designed by K-12 science teachers and students.
Web Address: http://www.cea.berkeley.edu/Education/

Site Name: *Center for Earth & Planetary Study*
Site Description: Sponsored by the Smithsonian Institution. The Center plays an active role in research related to planetary and terrestrial geology using remote sensing data from Earth-orbiting satellites and manned and unmanned space missions.
Web Address: http://ceps.nasm.edu:2020/homepage.html

Site Name: *Chemistry Pointers via the World Wide Web Virtual Library*
Site Description: More than a hundred online Chemistry Pointers via the World Wide Web Virtual Library.
Web Address: http://www.chem.ucla.edu/chempointers.html

Site Name: *Chris Halloran's Biology Web Page*
Site Description: Complete syllabi with links to lecture outlines, online readings, interactive activities, practice quizzes, tutorials, and correlated to benchmarks and standards.
Web Address: http://www.users.nac.net/challoran

Site Name: *Classroom Connect On-the-Net*
Site Description: The site is designed to help teacher's better understand and locate the Net's vast educational resources. Used in many schools as a "getway" to online information, this site contains many areas of great interest to educators.
Web Address: http://www.classroom.net

Site Name: Composting in Schools
Site Description: Interesting and useful information about composting, for both students and teachers. Find out about the biology, chemistry, and physics of composting, as well as tales of "Weird and Unusual Composting." From Cornell University's Center.
Web Address: http://www.cfe.cornell.edu/compost/schools.html

Site Name: *Coriolis Effect*
Site Description: This Web-based, interactive lesson plan is excellent for middle and high school science students studying this concept. Once the atmosphere has been put in motion by a high or low pressure weather system, it undergoes an apparent deflection
Web Address: http://www.atmos.uiuc.edu/covis/modules/forces/htm

Site Name: Cornell Theory Center Math and Science Gateway
Site Description: The Cornell Theory Center is committed to providing a wide range of educational services to the national community. This Gateway provides links to resources in mathematics and science for educators and students in grades 9-12.
Web Address: http://www.tc.cornell.edu/Edu/MathSciGateway/

Site Name: *Critical Issues Forum - Current Global Issue*
Site Description: A multi-disciplinary learning approach to global science issues designed by the Science Education Team of the Science Technology Base Division at Los Alamos National Laboratory. The open-ended curriculum model focuses on current projects.
Web Address: http://education.lanl.gov/resources/cif

Site Name: *Current Events in Environmental Science*
Site Description: Check out this site for a look at the state of our global environment and much more!
Web Address: http://www.voyagepub.com/publish

Site Name: *Current Weather Maps-Movies*
Site Description: Weather listings and images from all around the world.
Web Address: http://rs560.cl.msu.edu/weather/

Site Name: *Dimensional Analysis Lesson Plan*
Site Description: Grade 9-12 lesson plan which reviews important, basic facts about chemistry
and helps students put large numbers (moles) into the context of a real-world application.
Web Address: http://www.classroom.net/mole.htm

Site Name: Dinosaur Exhibit
Site Description: For the first time in Hawaii, there is a unique, free, permanent exhibit of dinosaur fossils available for public viewing. These "fossils" are replicas from the originals at the American Museum of Natural History in New York City.
Web Address: http://www.hcc.hawaii.edu/dinos/dinos.1.html

Site Name: *Earth Images*
Site Description: Earth observation images, taken by the Space Shuttle and brought to you via the NASA site.
Web Address: http://images.jsc.nasa.gov/html/earth.htm

Site Name: *Earth System Science Resource Center*
Site Description: Hyperlinks to other Web-based resources for Geology, Oceanography, Atmospheric Science, Astronomy, Geography, Environmental Studies, and several science-related organizations
Web Address: http://www.wadsworth.com/rcenters/earthnet/earth_s

Site Name: *Earth Viewer*
Site Description: An exciting site where you can view the Earth from any angle, see where the light and dark areas are at any particular time, and much more!
Web Address: http://www.fourmilab.ch/earthview/vplanet.html

Site Name: *Earthwatch*
Site Description: This site contains descriptions over 150 on-going field research projects worldwide and interactive links to scientists, virtual field trips, and access to the Earthwatch Global Classroom. It's your move!
Web Address: http://www.earthwatch.org

Site Name: *EcoQuest: Desert Edition*
Site Description: This is a WebQuest that causes students to study the desert environment through studying various roles. It is designed for middle school students.
Web Address: http://members.aol.com/QuestSite/1

Site Name: *Educational Space Simulations Project*
Site Description: The purpose of this web site is to promote the development of education via simulation. Although the primary focus of this site is space simulations, the concept of education via simulation is applicable to a wide range of disciplines.
Web Address: http://chico.rice.edu//armadillo/Simulations/simse

Site Name: *Electronic Zoo*
Site Description: The Electronic Zoo is a great source for animal-related information on the Web. It also contains veterinary resources and information about caring for pets.
Web Address: http://netvet.wustl.edu/e-zoo.htm

Site Name: *Energy Education Sites*
Site Description: As compiled by the U.S. Department of Education. A must visit for all science teachers.
Web Address: http://www.eren.doe.gov/education/

Site Name: *Engaging Science*
Site Description: Engaging Science is a pioneering Professional Development program for K-7 teachers, offering teacher training workshops, media resources and communication and support services. The program is a joint venture of the Pacific Space Centre, Sci
Web Address: http://www.engagingscience.org

Site Name: *ENIAC: The Birth of the Information Age*
Site Description: Learn about the ENIAC, the world's first computer, and how it sparked the Information Age!
Web Address: http://homepage.seas.upenn.edu/~museum/

Site Name: *Entomology (Insect) Resources on the Internet*
Site Description: A huge collection of Entomology links maintained by Colorado State University.
Web Address: http://www.colostate.edu/Depts/Entomology/ent.html

Site Name: *EnviroNet*
Site Description: EnviroNet is a network of teachers, scientists, environmental educators and others who utilize telecommunications to enhance environmental science education. Our monitoring projects include; AcidRain, BatNet, BirdWatch, CoyoteHowl Insect.
Web Address: http://earth.simmons.edu

Site Name: *EurekAlert!*
Site Description: EurekAlert! is a comprehensive news server for up-to-date research in science, medicine, and engineering. Whether you're interested in cancer treatments, gene mapping, global warming, or space probes, you will find the latest advances.
Web Address: http://www.eurekalert.org/

Site Name: *Everest Quest*
Site Description: Everest Quest: during the month of May, check out NOVA ONLINE for a virtual climb up the world's tallest mountain. Hear what the climbers have to say, see what they have to see. Learn about the mountain they are climbing.
Web Address: http://www.pbs.org/nova/everest

Site Name: *First Underwater Web Site Offers Virtual Porthole*
Site Description: "On Monday, April 15, with the help of the world's first underwater Web site, and leading-edge "video-streaming" technology [sends live video images over the Internet].
Web Address: http://www.aquarius.eds.com

Site Name: *Fisher Science Education On-line Service*
Site Description: The Fisher Science Education On-line Service is an extensive compilation of science resources and information. The web site includes pages such as: Sci-Ed Site Explorer, Teacher Tips, Weekly Special, New Product Directory and Science Calendar.
Web Address: http://www.fisheredu.com/

Site Name: Fledgling Corner - All About Birds
Site Description: Here are articles written with kids in mind - all about birds - how they act, information about many different species, etc. Beautiful graphics!
Web Address: http://birding.miningco.com/msubkids7.htm

Site Name: Flypaper Science Projects & Resources
Site Description: A web page developed by high school teachers to give a central source for science and math resources as well as projects that can be integrated into the classroom as extra work, or as an assignment.
Web Address: http://www.unk.edu/depertments/physics/CNMSC/flypa

Site Name: *Geological Time Machine*
Site Description: Let your students ride this World Wide Web time machine to different geological time periods--from the Precambrian to the Holocene! The Museum of Paleontology of The University of California at Berkeley is continually adding content to all
Web Address: http://www.ucmp.berkeley.edu/help/timeform.html

Site Name: *Guide to Math & Science Reform*
Site Description: The Guide to Math & Science Reform is a database containing information on nearly 1,000 projects and organizations involved in improving the way we teach mathematics and science. The Guide is funded by the Annenberg/CPB Math and Science.
Web Address: http://www.learner.org/k12/The_Guide

Site Name: Hearing, Seeing, and Smelling the World
Site Description: A colorful, animated site with articles and illustrations. Contents include: Stunning visual illusions. How we see colors. Discovering a "deafness" gene. A view of brain scans that spy on the senses. The mystery of smell and a Glossary.
Web Address: http://www.hhmi.org/senses/

Site Name: *History of Mathematics: Web Resources*
Site Description: A strong central resource, with many global links; an especially nicecollection of history oriented links, from Lewis Carroll (Dodgson) to Copernicus.
Web Address: http://aleph0.clarku.edu/~djoyce/mathhist/webresou

Site Name: *History of the Light Microscope*
Site Description: The history of the development of the microscope.
Web Address: http://www.utmem.edu/personal/thjones/hist/hist_mi

Site Name: *How to become an Astronaut!*
Site Description: Complete information about how to become an Astronaut, direct from NASA.
Web Address: http://www.ksc.nasa.gov/facts/faq12.html

Site Name: *Hubble Space Telescope Images (NASA)*
Site Description: Some spectacular images from the Hubble space telescope, plus some computer animations -- all direct from NASA!
Web Address: http://www.stsci.edu/public.html

Site Name: *Human Anatomy On-line*
Site Description: Human Anatomy On-line explains the functions of the human body in terms
students can understand. This site has an anatomy lesson that serves as an introduction to the parts of the body and how they work.
Web Address: http://www.innerbody.com/

Site Name: *IFIC Foundation On-Line*
Site Description: IFIC Foundation On-Line provides sound, scientific information on food safety, nutrition and health.
Web Address: http://ificinfo.health.org

Site Name: *Images & Mathematics*
Site Description: This is the Mathematics Archives' collection of links to sites to some very interesting graphics and art generated by using mathematics and animations illustrating mathematical concepts.
Web Address: http://archives.math.utk.edu/images.html

Site Name: *International Space Station*
Site Description: Curious to see what NASA has in mind when it comes to space stations? Check out their plans and drawings here.
Web Address: http://station.nasa.gov/

Site Name: *International Engineering & Robotics Apprenticeship*
Site Description: Have you ever admired the intricacies of an amusement park roller coaster? If you'd like to create your own bridge design, roller coaster design, speed boat, glider, or racing car, join us for the International Engineering and Robotics Apprenticeship.
Web Address: http://www.eden.rutgers.edu/~dmollica/index.html

Site Name: *International Hands-On Education and Science*
Site Description: Find out how students and teachers from over 3000 schools in 39 countries are working with research scientists to learn more about our planet.
Web Address: http://www.globe.gov/

Site Name: *Marine Life Database*
Site Description: This site was specifically designed to aid students of Voyage of the Mimi I in their study of Marine Life. It has fact sheets, maps, pictures, sounds, movies, and much more. It is very useful to any student studying Marine Life.
Web Address: http://panesu.esu14.k12.ne.us/~splummer

Site Name: *MicroWorlds: Exploring the Structure of Materials*
Site Description: An interactive tour of current research in the materials sciences at Lawrence Berkeley Laboratory, aimed at grades 9-12.
Web Address: http://www.lbl.gov/MicroWorlds/

Site Name: *Mr. G's Applied Technology Site*
Site Description: This site contains lessons, research links, and direct-drawing visuals of various applied technology projects such as catapults and Eiffel Towers.
Web Address: http://www.sd68.nanaimo.bc.ca/schools/coal/at/at.h

Site Name: *National Fish and Wildlife Foundation*
Site Description: The NFWF is a nonprofit organization dedicated to the conservation of natural resources -- fish, wildlife, and plants. Their site contains project initiatives, publications and related links.
Web Address: http://www.nfwf.org/

Site Name: *Nine Planets Tour*
Site Description: This is an essay about our solar system with text, pictures, sounds and an occasional movie. Each of the planets and major moons in our solar system is briefly described and illustrated with hundreds of pictures from NASA spacecraft.
Web Address: http://seds.lpl.arizona.edu/billa/tnp/

Site Name: *Science Education Resources, MHS*
Site Description: This site provides links to over 200 science/education related sites. There are links to environmental science, genetics, science and ethics, evolution, and chemistry sites, virtual field trips, resources for teachers and more! Come check
Web Address: http://www.milpitas.k12.ca.us/mhs_website/departme

Site Name: *Super Science HomePage*
Site Description: This site is designed to encourage students, teachers and parents to do scientific experiments. It includes ideas for experiments, advice on performing and presenting
experiments, an on-line contest and information on exciting books.
Web Address: http://www.superscience.com/home.html

Site Name: *The Cygnus Group*
Site Description: The Cygnus Group Web site is designed to provide information regarding the most efficient and effective ways to reduce waste and conserve resources. The focus is on source reduction and reuse, rather than just recycling.
Web Address: http://cygnus-group.com

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BIOGRAPHICAL SKETCH

Faris A. AlFaraidy was born in the Kingdom of Saudi Arabia, in the capital city of Riyadh. In 1989, he received his Bachelor's Degree in Architecture from the College of Architecture and Planning at King Faisal University in Dammam, Saudi Arabia. He was then appointed a Teaching Assistant position in the Department of Building Science and Technology at the College of Architecture and Planning. He pursued his graduate studies at King Faisal University where his finished his Master's Degree in Building Science in 1993. As a Lecturer, he taught for two years at the College of Architecture and Planning. In fall 1995, he was granted a scholarship from the Saudi Arabian government to pursue his graduate studies in the Ph.D. program from the College of Architecture at the University of Florida in Gainesville, USA.

In 1998, at the University of Florida, he received a certificate of achievement award for outstanding academic achievement and participated in the TEACH-IN '98 at the University Center for Excellence in Teaching. He is a member of the Council of Educational Facility Planners International. He is also a member of the International Interior Design Association. After finishing his Ph.D., he will return to Saudi Arabia with his wife and four children, Tariq, Ziyad, Areej and Faisal. He will return as a faculty member in the College of Architecture and Planning at King Faisal University.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

R. Wayne Drummond

R. Wayne Drummond, Chair
Professor of Architecture

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